

# NATURAL HISTORY

## PAST RACES OF MAN

### THE CAVERN OF LES COMBARELLES

Great art gallery of the mammoth hunters

THE ABBÉ HENRI BREUIL

### FOSSIL MEN IN CHINA AND MONGOLIA

Late Palæolithic predecessors of Chinese civilization

PÈRE TEILHARD DE CHARDIN

### HOW NEANDERTHAL MAN HUNTED CAVE BEARS

Great beasts slain in the Dragon's Cave at Mixnitz

OTHENIO ABEL

### TAUNGS AND ITS SIGNIFICANCE

South Africa's arid veldts produce a super-ape

RAYMOND A. DART

### CASTS OBTAINED FROM THE BRAIN CASES OF FOSSIL MEN

Later stages in the rise of human faculties

G. ELLIOT SMITH

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JOURNAL OF THE AMERICAN  
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# NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY,  
EXPLORATION, AND THE DEVELOP-  
MENT OF PUBLIC EDUCATION  
THROUGH THE MUSEUM



## PAST RACES OF MAN

EDITORS  
WILLIAM K. GREGORY  
CHRISTINE D. MATTHEW

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MAY—JUNE, 1926

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# NATURAL HISTORY

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Copyright by Charles R. Knight

A LATE AFTERNOON IN THE OLD STONE AGE

Courtesy of the artist, Charles R. Knight. The original color sketch was painted under the direction of Henry Fairfield Osborn

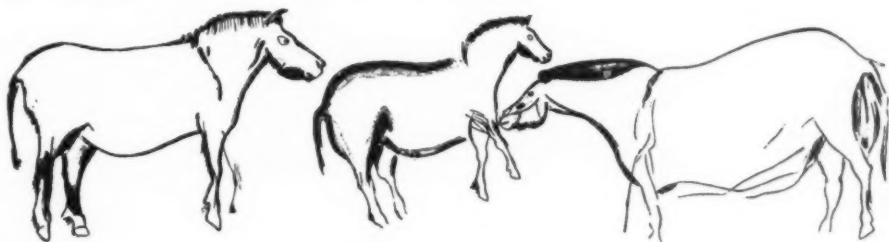
Not an imaginary picture but—apart from such unrecoverable details as skin color—a well-documented restoration of the Neanderthal flint workers

# NATURAL HISTORY

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Group of three small black horses

## The Cavern of Les Combarelles

BY THE ABBÉ HENRI BREUIL

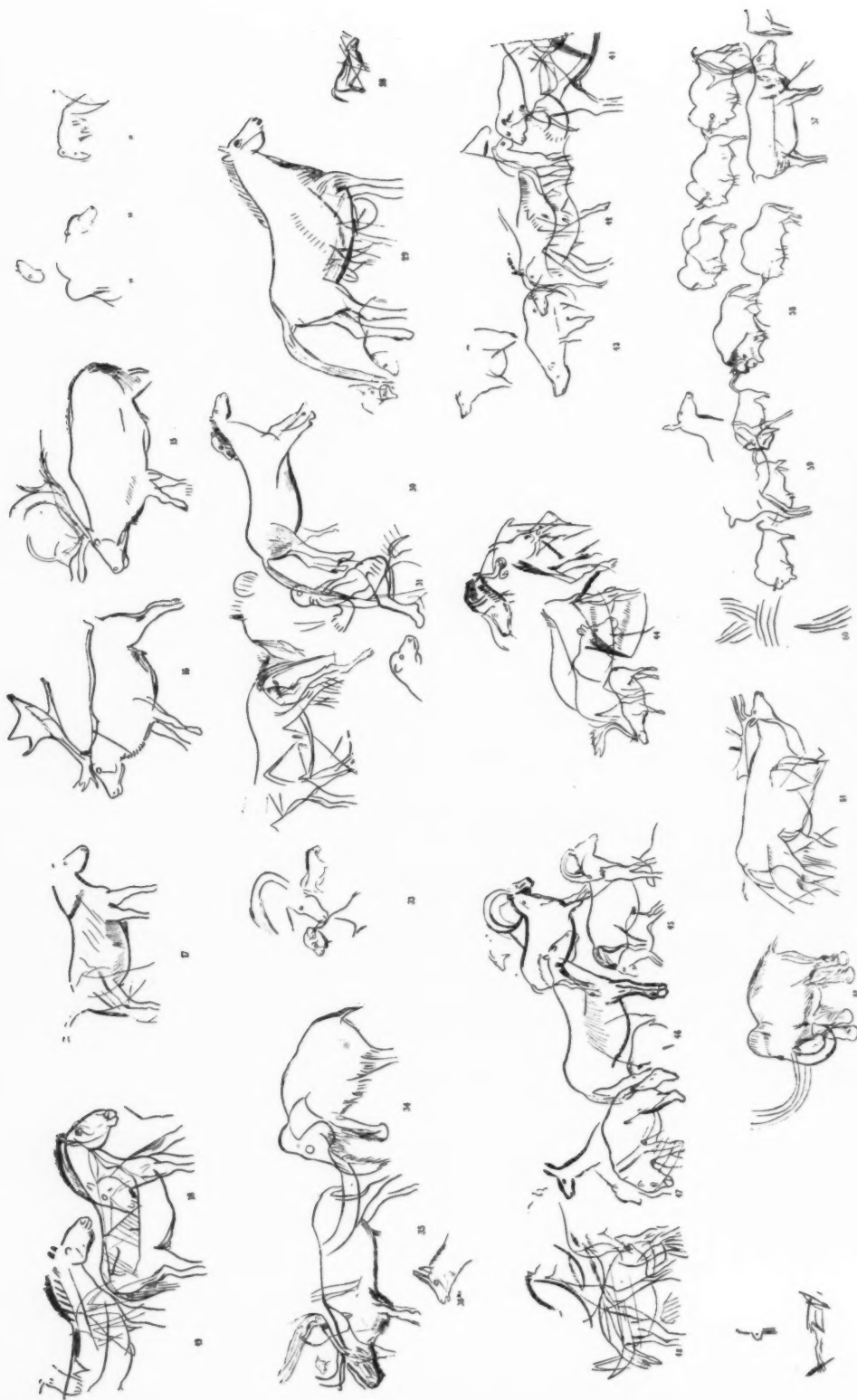
TRANSLATED BY CHRISTINE D. MATTHEW

IT was on September 2, 1901, that, in company with Doctor Capitan and M. Peyrony, I penetrated the low, narrow passages of the cavern of Les Combarelles, the entrance to which—at the bottom of a small valley lying laterally to the Beaune, a tributary of the Vézère—was concealed by a cow stable, and is about a mile and a quarter from the famous site of Les Eyzies. Previously Dr. E. Rivière had made some excavations in a dark passage on the right, at the entrance, where he discovered a Late Magdalenian deposit with abundant specimens of worked bones, chipped flints, needles, and harpoons, associated with bones of reindeer, chamois, horse, and bison; but being confident that there were no deposits in the passage to the left, he abandoned further exploration.

It was this opening to the left we had determined to investigate. Enduring extreme discomfort, we made our way along the low-roofed passage where, about 520 feet from the entrance, we saw that the two walls were engraved with numerous confused and interlacing designs almost in-

variably covered by stalagmitic deposit exuded from the rock. A hasty examination showed animal figures more or less deeply incised, among which we at once recognized reindeer, a number of horses, and several mammoths, while each moment spent exploring this unique and tortuous gallery enhanced the importance of our discovery. At one time we thought we had reached its end on finding a small recess, some 620 feet from the entrance, ornamented with a magnificent engraving of the cave bear. But then we espied in a corner a very low opening where it was barely possible to wriggle along on one's stomach over the bosses and points of stalagmite which made the ground a thorny way.

After about forty feet of this the roof became somewhat higher so that we could rise to our knees. The designs we now saw were finer and less obscured by the stalagmitic glaze, although the bottom of many of them was below the ground, which consisted of gravel covered by a thick layer of stalagmitic deposit. Among them we noticed several pretty little horses painted in black.



DRAWINGS OF THE CAVERN OF LES COMBARELLES  
Part of the pictorial key to the entire series





VIEW IN THE GALLERY OF ENGRAVINGS, CAVERN OF LES COMBARELLES

The passage now narrowed to an opening fourteen inches high and twenty-two inches wide, which I alone was able to crawl through—thus discovering still more designs half-buried in gravel covered by stalagmitic concretion. A pool of water lay across the path beyond which—about 780 feet from the entrance—I stopped before a crevice too narrow for passage. It leads, as we learned later after enlarging the crevice, to a lower gallery with no prehistoric remains, where flows a stream of water that can be followed only for a short distance.

At the time of this discovery the only cave in the neighborhood of Les Eyzies known to be ornamented with designs was the grotto of La Mouthe, discovered six years previously by E. Rivière. Five years previously F. Daleau had announced that on the walls of the little grotto of Pair-non-Pair, Gironde, buried under archæologic deposits of the Age of the Reindeer containing bones of reindeer, rhinoceros, hyena, cave bear, and mammoth, there were rude designs of Capridæ and Equidæ. The discovery in 1878 of the polychrome frescos of Altamira, near Santander, Spain, by the Marquis Marcelino de Sautuola, was very unjustly discredited and by this time almost forgotten.

The discovery reported at La Mouthe had been violently denounced by many prehistorians who also lost no time in combating *a priori* the authenticity of the engravings at Les Combarelles, attributing them—in the face of all probability—to political refugees of the time of the first Napoleon.

A week later we had word from M. Peyrony that in a cave even nearer to Les Eyzies, that of Font-de-Gaume, numerous paintings had been found—

red, black, and polychrome—many of them similar to those of Altamira, though not so well preserved and in part thickly covered by stalagmitic deposit. During the following years we found engravings like those of Les Combarelles at the neighboring sites of Bernifal and La Calévie. The frescos at Marsoulas, Haute Garonne discovered by Felix Regnault, were examined by Emile Cartailhac, who publicly demanded a reconsideration of the judgment passed on Altamira, and—to complete his "*Mea Culpa d'un Sceptique*"<sup>1</sup>—invited me to join him in investigating the frescos.

Since then there has been a continuous series of discoveries in the caves of Périgord and the French Pyrenees; an equally important region has come to light in the Cantabrian Mountains of Spain; and additional discoveries in Andalusia, Provence, and Italy, have brought the number of caves and rock shelters now known to be decorated with sculptures, engravings, or paintings, up into the seventies. Cases where painted, engraved, or sculptured fragments obviously broken off the walls have been embedded in undisturbed deposits are so numerous that it is no longer possible to question the Palæolithic age of this remarkable ensemble of artistic work.

But in 1901 the discovery of the engraved cavern of Les Combarelles created a veritable sensation, exciting the liveliest interest in scientific circles, and inaugurating an era of fruitful explorations which have notably advanced our knowledge of the civilization of Late Palæolithic times and of the magical and religious beliefs which then prevailed. Excellent scientific

<sup>1</sup>Title of the article in which, after long incredulity, M. Cartailhac announced that, as the result of his investigations, he was now completely convinced of the authenticity of the Palæolithic paintings.









**WILD CATTLE, CAVERN OF LES COMBARELLES**  
Note the delicacy of the treatment in contrast with the bold handling of the rhinoceros



#### THE WOOLY RHINOCEROS

Detail of a complete outline sketched by the artist-hunter on the limestone wall of the Cavern of Les Combarelles







romances of the present day—such as *Les Bisons d'Argile* by Max Bégouen, and *Le fin d'une Monde* by Claude Anet—which familiarize the general public through a medium less tedious and didactic than scientific reports with conclusions reached through the investigations of the last quarter-century, owe their inception to activities that began with the discovery of Les Combarelles.

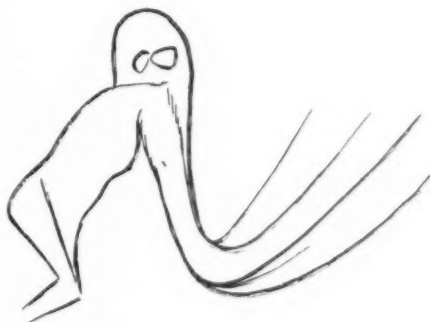
The study of this cavern—of hundreds of tangled and interlaced designs on the walls of a damp, low, and narrow passage—was entrusted to me, and involved numerous wearisome visits to decipher, trace off, and photograph the various figures. On account of the risk to health and the extreme fatigue involved, it took fully twelve years to complete this work which was frequently interrupted by the exploration of many other caves in France and Spain. Finally, in collaboration with MM. Capitan and Peyrony, I published the full description in 1924,<sup>1</sup> in one large volume, on account of which I was honored by the award of the Elliot medal from the National Academy of Sciences in Washington.

It is the results recorded in this volume which I now propose to discuss, together with additional comments and inferences.

Although the number of engraved designs at Les Combarelles exceeds 400, only the following could be deciphered: 116 Equidæ (chiefly horses but also a few asses or kiangs), 37 bison, 19 bears (cave bear and brown bear), 14 reindeer, 13 mammoths, 9 ibexes, 7 wild oxen, 5 stags, 3 does, 1 Dama deer, 5 lions, 4 wolves, 1 fox, 1 woolly rhinoceros, 1 fish (?), 1 snake (?), 4 designs of huts of the type called

tectiform (tentlike) on account of the form of the roof, and a hand silhouetted on a black background. In addition there were several graphic signs, exceedingly simplified, representing javelins and sexual symbols.

The most recent of these designs are those of the mammoth, of which only two or three representations—engraved on bone or ivory—were then known; the woolly rhinoceros, previously unknown in Paleolithic art; the cave



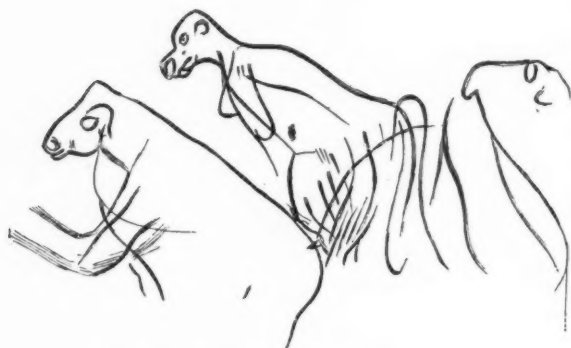
Man wearing a mammoth's-head mask.  
The arms immitate the tusks

bear, of which the only other representation known at that time was engraved on a small stone from the grotto of Massat, Ariège; and the great cave lion, possibly portrayed in an engraving of doubtful interpretation on a fragment of reindeer antler found at Bruniquel.

The human figures were so extraordinary that at first we were at a loss how to interpret them. The bodies—in general wretchedly drawn, in comparison with the splendid realism of the animal figures—were frequently topped by heads that were anything but human, although hardly belonging to any particular animal. Only comparative ethnology afforded a reasonable interpretation of these designs as probably indicating an extensive use

<sup>1</sup>L. Capitan, H. Breuil, and D. Peyrony. *Les Combarelles aux Eyzies*. Masson et Cie., Paris, 1924.

of ceremonial masks and of hunters' disguises—an interpretation confirmed by the unmistakable evidence of later discoveries.



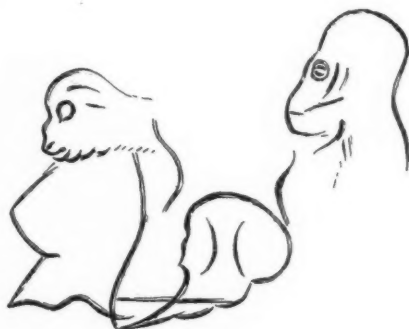
Ceremonial masks of uncertain significance

It is none the less strange that the anthropomorphic designs of Les Combarelles and other caves, as well as those of the same epoch engraved on bone or stone, should be so ambiguous and crude, in contrast to the magnificent artistic development shown in the animal designs. The explanation may perhaps be found in the existence of some sort of taboo prohibiting portrayal of the normal human form—a prohibition which was not so strict at the beginning of Late Pæololithic time when sculptors worthy of the name carved in ivory or stone the female figurines of Brassempouy, Lespugue, Grimaldi, and Willendorf, and the male and female reliefs of Laussel.

On the other hand, the art of animal representation at Les Combarelles was highly developed; its beginnings were long past. The engraver made his designs with a precise and assured technique. First, with his flint, he lightly outlined the main features of his projected design, with no uncertain touch, upon a hard, rugged, and irregular surface—and this by the feeble light of a tallow lamp, perhaps

merely a flat or hollowed stone, or possibly a lump of grease with a small wick inserted. He then cut, deeper the silhouette which he had sketched, scraped the lines smooth, sometimes chiseled them out still more to give an effect of modeling or relief, which suggests the further development of relief shown in the magnificent frieze of horses at the neighboring station of Cap-Blanc. The finishing touches consisted of still finer lines to indicate certain minute details, such as the hair, mane, or nostrils. In rare cases color was

used to supplement the engraved line; bluish or black streaks are found here and there, and perhaps it is permissible to suggest that organic colors, such as blood, may possibly



Grotesque human heads or masks

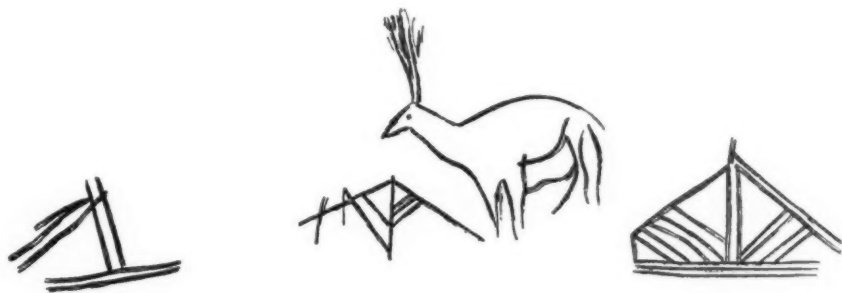
have been used, but have not lasted, for we know that even now blood is the favorite color used by Australian natives for their tribal art.

It is only in a few figures far back in the cave, representing small horses, that black is most skilfully and effectively used to silhouette the designs in which both line work and filling in denote the hand of a true artist. A

little mineral red ocher is used only in outlining two of the huts.

These "tectiforms" are rare here, although abundant at some other sites where they are generally found in remote recesses. Dr. Hugo Obermaier has compared those found in Spain to the "traps for evil spirits" used by the negritos of Malaysia. But it seems to me these "spirit traps" might also

stage of development. On the other hand, they had ceased to make realistic human forms like those left by the ancient "Aurignacians" of Laussel about three miles away. Their most interesting designs are figures of animals engraved or carved in very low relief. We have already spoken of the most remarkable, but the others—though less extraordinary—are also



Three tectiforms and badly drawn deer

serve as tiny dwellings where the spirits might take up their permanent abode, and thus cease to torment mankind. Or again these tectiforms—painted in the innermost depths of the Palæolithic caves—might be intended to localize certain unearthly powers, otherwise undesirable, and to capture their puissance by means of a sort of "tabernacle." This is one aspect of the "mysteries," of the doctrines and ritual practices, which led to the strange assemblage of designs in dark underground passages—in some cases very deep and dangerous, in others uninhabitable and difficult of access, as at Les Combarelles.

For the present, however, we will leave these problems.

The artists of Les Combarelles were ignorant of the advanced technique of mural painting as shown in the cave of Font-de-Gaume, less than a mile distant, where the art belongs to a later

worthy of study. Examined from an artist's viewpoint they show a profound realism with no affectation. They also show many inaccuracies and negligences which may be due in part to hasty execution, but also to the rocky surfaces, roughened with bosses and holes, on which the artist had to work.

This realistic art, long known from carvings on small objects discovered since before 1860, and so superior, taken all in all, to the works of ancient civilizations, did not arise during an advanced state of cultural evolution, but is due to the fact that among hunters life itself depends closely on keen eyesight, which tends to the development of a memory for form, and a faculty for accurate observation. Thus it comes that we find designs equally worthy of admiration among such primitive peoples as the Bushmen, the Australians, and the



SMALL REINDEER



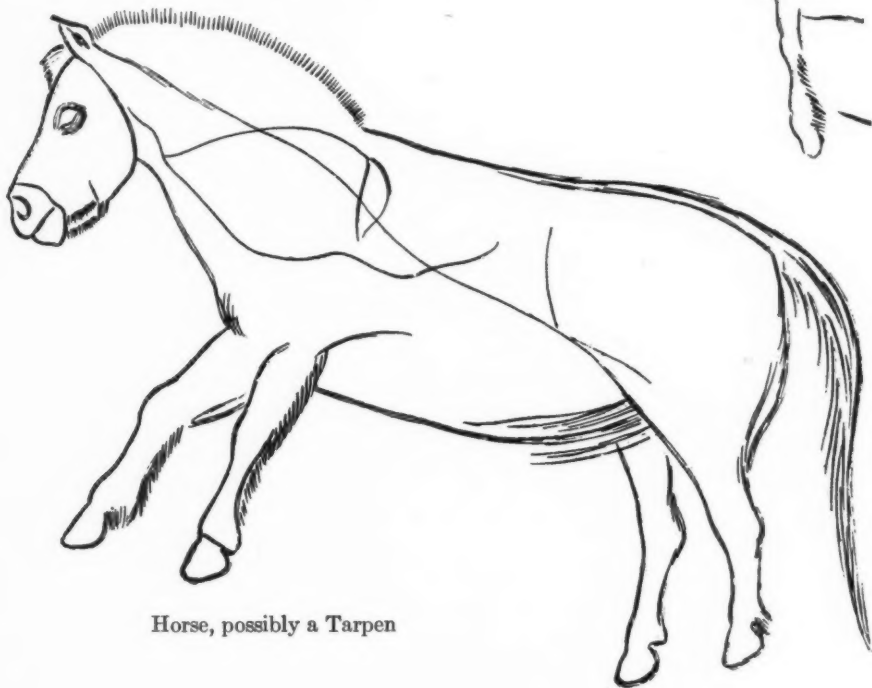


LIONESS

Eskimos. If it occurs to a hunter to draw, he will always draw well, for he knows how to see accurately, and how to remember what he has seen.

It follows that the designs left by the artists of Les Combarelles have a genuine zoölogic value, and deserve to be considered from this point of view—always remembering, however, that our scientific viewpoint was unknown

time, bears witness to a great diversity of race at that time and in that region. Even allowing for the differences in appearance caused by age, sex, or season in our artists' models, one also



Horse, possibly a Tarpen

to them, and that they made their pictures from memory. With this in mind, the study of the designs of reindeer at Les Combarelles, for instance, suggests that the variety they sought to portray was related to the "woodland caribou," which is quite what might be expected in a region close to the southern limit of the distribution of reindeer in western Europe at that time.

Similarly, the study of the designs of horses, on which I have spent much

finds a combination—at times quite unmistakable—of different types in the same design. The following are clearly recognizable:

(1) Nordic horse—head heavy, back long, muzzle sometimes decidedly arched.

(2) Celtic horse—head small, back short, rump often rounded.

(3) Lybian horse—profile sinuous, head not heavy, back short and straight, rump not sloping, form lightly built.



(4) Tarpan—head short and thick, back short and straight, tail short, rump not sloping.

(5) An unmistakable ass.

(6) Two kiangs (? probably).

One salient fact is the great number of game animals represented, in contrast to the comparative scarcity of carnivores, while certain carnivores, such as the bear, the meat of which is decidedly palatable, are as frequently pictured as the reindeer. It may legitimately be inferred that the portrayal of these figures was closely connected with the noble art of venery, so essential in those days to the very existence of the peoples of Périgord.

The enormous preponderance of figures of horses here, whereas the bison is dominant at Font-de-Gaume, is doubtless referable to the game preferred by the people of Les Combarelles, but may also be connected with a "division of labor" in hunting magic for each special tribe. For one always comes back to the viewpoint of sorcery to explain—in the light of ethnographic facts—this astonishing development of art in caves so dark and difficult of access.

Doubtless these people loved art for art's sake, but in their environment art—born of the delight of creative work, interesting in itself, and able, through contemplation, to renew the pleasure originally evoked—would not have attained such wide scope if it had not appealed to the strongest interests, to the desire for food, for an abundance of game (magic of reproduction), and for success in obtaining it (hunting magic). To picture a mare, especially giving birth to young, would promote the natural increase of horses. To portray the great cave bear with many

javelins sticking in him would assure success in hunting him.

Such were the beliefs that inspired the engravings and paintings of Palaeolithic times, which were doubtless executed with ritual solemnity by a caste of sorcerers trained to the work as to a sort of liturgy, in haunts forbidden to common folk and accessible at certain seasons only to the initiated, disguised in their ceremonial habiliments.

Indeed, without straining probability, one might imagine that the people of the Age of the Reindeer celebrated ceremonial feasts something like the "Inviting-in-feast" of the Eskimos held at the winter solstice, in the dead season for hunting, when by means of invocations, propitiations, masquerades, and pantomimes they seek to find favor with the souls of animals hunted and killed during the past summer, so that they may be re-incarnated by order of the Great Spirit who rules all the cosmic forces. This was also the time for initiating younger members of the tribe who had reached the proper age into their sexual and social obligations, and to teach them the tribal mysteries and the traditional "catechism" treating of all man needed to know of the world, visible and invisible.

The hunters of the Reindeer Age—simple and elementary as their life was—are by no means to be classed as primitive. From the standpoint of geologic age (about 20,000 years), of human racial types, and even of social organization, they are far nearer to us than they are to the flint workers of Cromer who may date back to a million years ago. They are among our direct ancestors, and their race is not extinct.



Fig. 1.—Map of Palaeolithic beds in the vicinity of Ordos. From Licent and Chardin, 1925

## Fossil Man in China and Mongolia

By PÈRE TEILHARD DE CHARDIN

TRANSLATED BY CHRISTINE D. MATTHEW<sup>1</sup>

IN the immense expanse extending from the Himalayas to the Altai Mountains, Pleistocene deposits—that is to say those in which the palæontologist has some chance of discovering traces of fossil man—are represented by thick formations known locally as the Yellow Earth (Hwang Tu). Sometimes the Yellow Earth has been deposited chiefly by the wind, on hill slopes, and then it is granular: this is the loess. Sometimes it is accumulated in the form of dunes or of alluvial deposits, in wide-open basins, and then it is sandy or mixed with layers of clay deposited by ancient lakes or rivers.

The Yellow Earth of China and Mongolia seems to be for the most part contemporary with the loess formations deposited in Russia and in western Europe during the last glacial stage. All together, in fact, they form one continuous mantle containing one and the same fossil fauna—woolly rhinoceros, giant deer, cave hyena, camel, etc. But, until very recently, no trace of man had ever been discovered in this mantle to the south or to the east of the Yenisei. Plainly there were excellent grounds for supposing that man had lived on the Chino-Mongolian plateau in Palaeolithic times—that is, before the advent of those Neolithic

<sup>1</sup>[Author's spelling of Chinese names retained.—Ed.]

people whose implements and pottery are found in the deposits of black earth superposed upon the Yellow Earth. But there was no convincing proof of this presumed antiquity of man in China.

This proof I had the good fortune to secure in 1923 when—sent by the Paris Museum to study the palæontology of Mongolia—I explored the Bad Lands of Ordos at the very time when my friends of the Third Asiatic Expedition of the American Museum of Natural History were exploring the similar regions of the Gobi Desert. In the southern part of the rectangular desert plateau enclosed by the great bend of the Hwang-ho, my guide—Père Licent, director of the Tientsin Museum—and I discovered three sites containing indubitable traces of Palæolithic man, with stratigraphic conditions and associated fossils that are beyond question.

The first of these sites is more than thirty miles east of the city of Ning-hia-fou, not far from the Ala-chan Mountains. One day, as my friend Père Licent and I were following along a ravine known as the Choei-tong-k'eu, crossed by a brook in a small loess basin, we were surprised to notice in the cliff of loess, at a depth of about forty feet, a well-marked layer of worked stones and broken bones, and we then realized that we had before us a Palæolithic "hearth" absolutely like those I had so often seen in the grottos of France and Spain. The stratigraphic study of the deposit shows that this site was inhabited by man at the commencement of the formation of the loess. Then dust and sand slowly accumulated upon the ancient surface where he had lived, forming a covering at least fifty feet thick. Afterward there was a river,

the gravels and mud of which partly cut into and covered the loess. Later the whole accumulation was dissected and planed off, thus forming a new surface where Neolithic man lived, and since then the region has experienced only a course of progressive dissection throughout historic time.

In the "hearths" of Choei-tong-k'eu (for there are several) the animal remains are varied, though not abundant, and include the kiang, aurochs, argali sheep, gazelle, woolly rhinoceros, hyena, and ostrich. On the other hand, the implements of worked stone are plentiful. From a single hearth we collected nearly a thousand kilograms (2200 lbs.). Generally they are coarse implements of quartzite—worked flakes or blades similar to the Mousterian and Aurignacian implements of Europe. But there are also small flint implements, of much finer type.

In the region of Ning-hia-fou the Pleistocene deposits consist of loess not more than 65 feet thick, but 150 miles farther east they reappear, in the form of sands, in much greater volume along the course of a river, the Sjara-osso-gol, which has worn a cañon 230 feet deep into deposits which are exclusively Pleistocene. It was while exploring the walls of this cañon, hunting for fossil bones, that we again encountered traces of Palæolithic man at a depth of some 180 feet below the actual level of the steppe. As at Choei-tong-k'eu these traces were evidently deposited upon the ancient surface of the ground, which later had been gradually buried beneath mighty dunes and bog deposits. But here, clearly, the thickness of the sedimentary covering was unusual.

As to the evidences of human activity, but few stone implements



Fig. 2.—Neolithic beds near Linn-si (Eastern Mongolia). All the stones visible on the ground are those brought there and broken by the Neolithic workers. They are embedded in the black earth which borders the basin



Fig. 3.—A few Palæolithic implements from Choei-tong-k'eu



Fig. 4.—Palaeolithic beds of Choei-tong-k'eu at the time of discovery. The "hearth" begins at the point where the man at the right touches the cliff



Fig. 5.—After the excavations. The position of the "hearth" is marked by a dark line to the left of Père Licent, who is looking at it





Fig. 6.—The cliffs of Sjara-osso-gol. The Palæolithic remains were found a half mile from this point, at a depth marked by the white star

were found at Sjara-osso-gol, and these were astonishingly small—often simple gravers the size of a hazelnut, retouched in every sense of the word. They were scattered through an enormous accumulation of broken bones of animals which were much fossilized and belonged to a great variety of species including woolly rhinoceros (complete skulls), elephant, kiang, aurochs, gazelle (in hundreds), camel, cave hyena, giant deer, and shells of ostrich eggs. An important series of antlers seems to have been broken intentionally to use as handles for tools or as maces.

In spite of the great depth at which these remains were found, we do not believe that the date of man's occupancy here was much more ancient than at Choei-tong-k'eu. However, the style of the implements differs so much at these two sites that they should

probably be considered as representing two different cultures, and possibly two different human races.

The third and last site where we discovered traces of Palæolithic man in 1923 is about 90 kilometers, (55 miles) south of Sjara-osso-gol, in the district of Yu-lin-fou, Shensi, near the village of Yu-fang-t'eu. In this region the ground consists of an enormous thickness of loess, beneath which lies the Red Earth containing remains of *Hipparion*, and the Jurassic sandstone. In places this loess attains a thickness of 500 feet, and between it and the underlying deposits there occurs everywhere an intervening layer a few yards thick formed entirely of débris—chiefly calcareous concretions—accumulated by fluvial action at the beginning of the loess formation. These gravels at the base of the loess are destined to be of prime importance





Fig. 7.—The excavations of Sjara-osso-gol

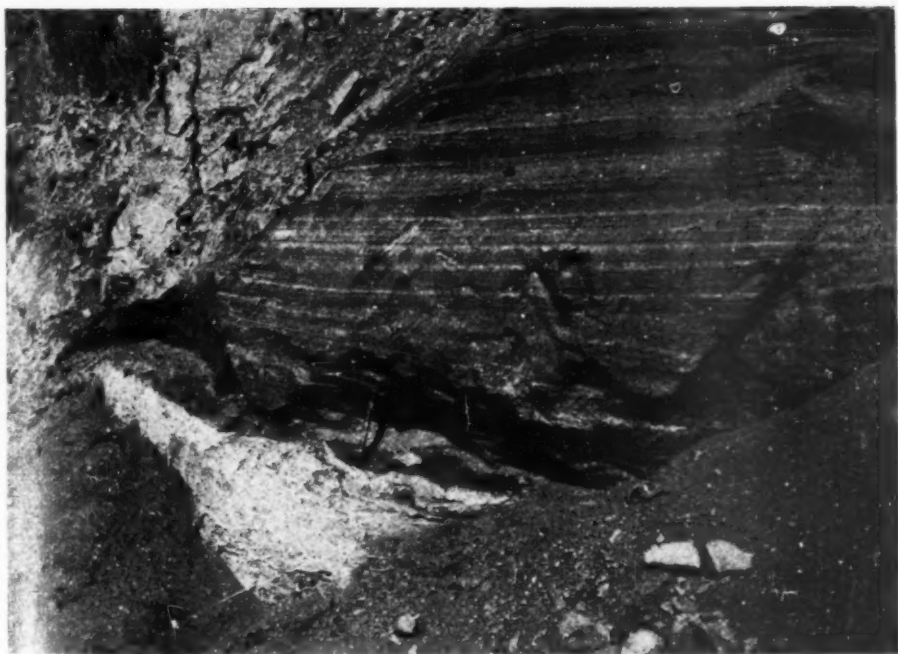


Fig. 8.—The old Palæolithic soil of Sjara-osso-gol. All the bones and the tools (flints) lie on the surface of the lower clay bank, below the stratified sandstone

to the prehistorian for it is here—just below the loess, strictly speaking—that we collected a small number of quartzite flakes which have certainly been fashioned by man. The implements were not assembled at the site of an

lithic man lived in China not only during the formation of the loess, but from its very beginning, and perhaps even earlier. Thus man has seen China without its mantle of Yellow Earth, which gives us a vivid realiza-



Fig. 8.—A gorge in the country of the great loess (Shensi). The gravels at the base of the loess, containing the Palæolithic flints, form the horizontal cornice seen in the middle of the photograph

ancient camp, as at Choei-tong-k'eu and Sjara-osso-gol, but were scattered throughout the gravel. This makes them much more difficult to find, but, on the other hand, their area of distribution is very extensive. Indeed, ever since 1920 Père Licent has from time to time found similar implements in the same gravels at the base of the loess in the neighborhood of K'ing-yan-fou, Kansou, about 125 miles southwest of You-fang-t'eu.

The discovery of worked quartzites in these gravels proves that Palæo-

tion of his antiquity in the Far East. Great as it is, however, this antiquity is as yet less than the known antiquity of man in the West. The loess, as we have said, seems to correspond to the latest stages of the Glacial Epoch in Europe and America. If this is true, then man of the Yellow Earth is far more recent than, for instance, man of the gravels of Chelles and Saint Acheul.

The antiquity of man in China and Mongolia will not compare with that already known for man in Europe until we know if man (and what species of

man) peopled eastern Asia at that period when, for the last time, the hippopotamus wallowed in the rivers of England. And not only do we know no answer to this question: as yet we can but guess what regions may supply that answer.

In conclusion, it is of the greatest importance to connect the Palæolithic sites of Ordos with those of Siberia, and to discover human fossils there. Only when a correspondence has been

established between the Palæolithic industry of China and that of Russia, and when we have a skull of the man of Sjava-osso-gol or of Choei-tong-k'eu—only then will we be able to determine whether the resemblances of the stone implements of Ordos to the Mousterian and Aurignacian implements are cases of simple convergence, or whether they indicate an actual relationship, either through contemporaneity of time or community of race.

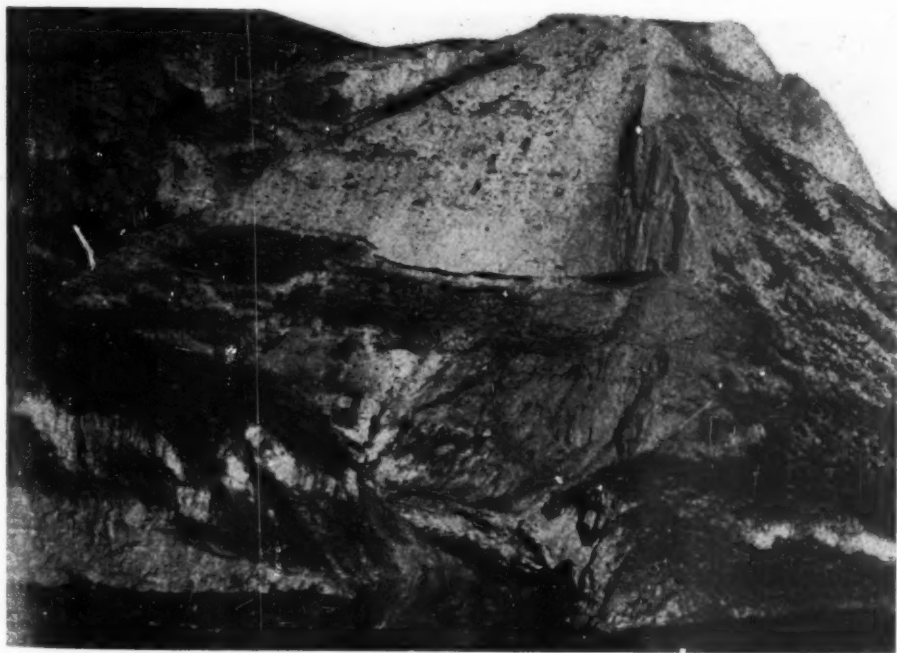


Fig. 10.—Another view in the country of the great loess. As in Fig. 9, the gravels at the base of the loess again form the horizontal cornice in the middle of the photograph

# The Dune Dwellers of the Gobi

By N. C. NELSON

Associate Curator of Archaeology, American Museum

WHEN several years ago it was proposed that archaeology be included in the program of the Third Asiatic Expedition, the suggestion seemed of all things the most natural. Was not Asia the cradle of human kind, and were not the elements of all Occidental cultures—American as well as European—derived largely from the Orient? Next to a systematic search for evidence of Quaternary man at home in America, the most worth-while adventure for one interested in human prehistory was certainly the opportunity to investigate the archaeology of the Far East.

And then about a year ago the opportunity arrived. All at once it became necessary to divest the term "Orient" of its enveloping mystery, its glamour and romance, in fact to prepare to meet the hard reality face to face. The new situation put one's faith to the test. Positive historical data about the overflowing East began to seem few and far between. Traditions were not of the stuff that inspired confidence. And as for current scientific hypotheses, developed by my own colleagues in their comfortable studies, about "Central Asia as the original home of the human species," etc., all the known facts were against them. No one had ever discovered a positive trace, say, of Palæolithic man in the Far East, and as for Asia being the mother of all the nations, what was that but a piece of flattering Occidental sentiment?

However, Leader Andrews stood ready with the money and the American Museum granted the time—the least

I could do was to go. But throughout the long journey to Peking it was borne in upon me more and more forcefully that the venture was a bit foolish. Some who, it seemed, ought to know, were even frank enough, in parting, to tell me so; and on my arrival in China the prospects did not at once materially brighten. The times were far from auspicious and the field apparently had either been worked or was in some sense preëmpted. Still, no one had any immediate designs on Mongolia, particularly the Gobi Desert; indeed, there were those who were far too ready with the suggestion that the Gobi would be an especially desirable place for me to go, even though a desert would appear to be the last place in which to look for relics of prehistoric man.

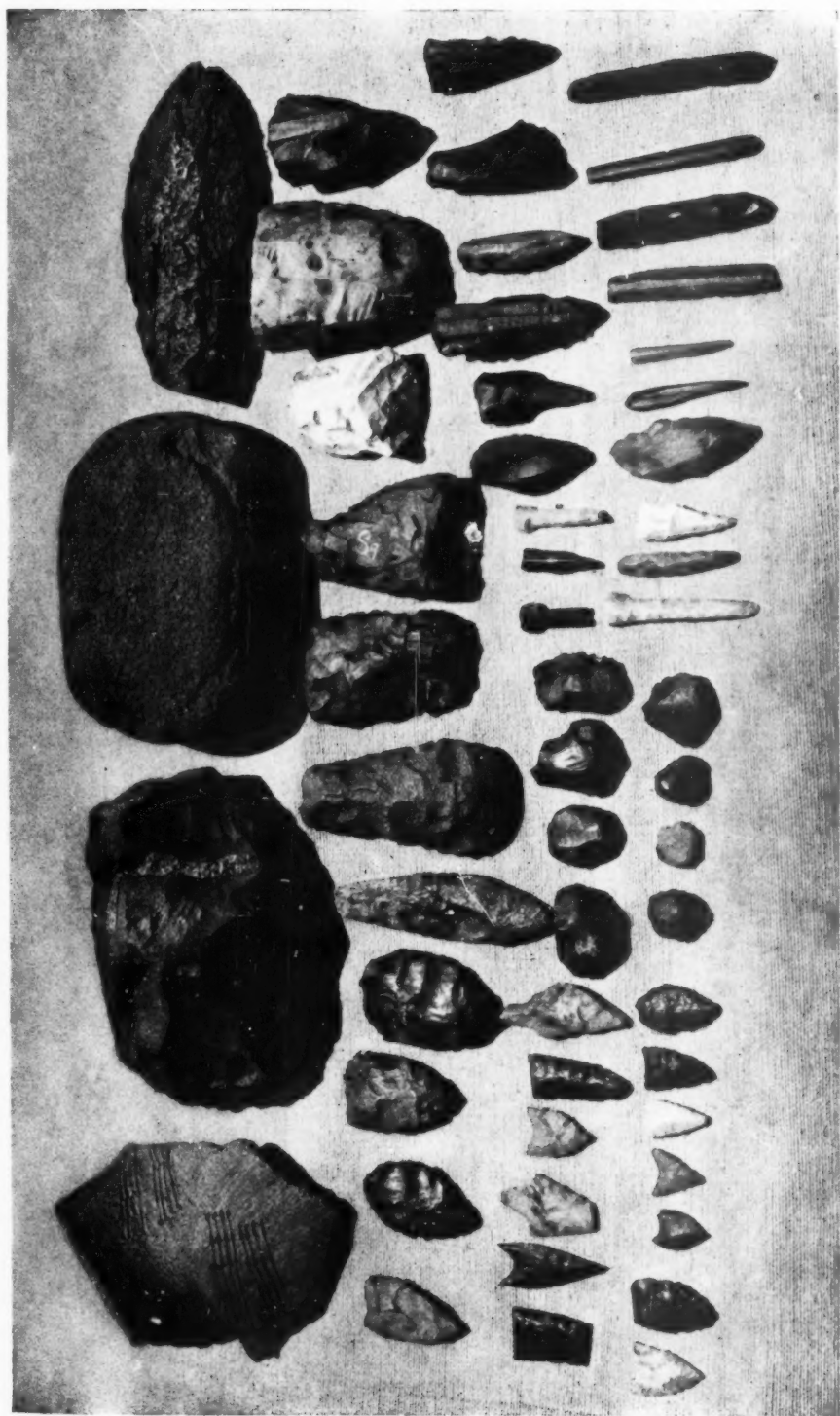
Fortunately, it had been my own original choice to make Mongolia the first objective; so that if all attending circumstances seemed to send me there no one was more pleased than I. And why not look for archaeological remains in a desert? It is one of the easiest places in which to find such things if they are really there. Besides, had not the Sahara and other African deserts furnished an abundance of relics of all ages? Deserts have not necessarily always been deserts, and we have the word of our own anthropogeographer, Ellsworth Huntington, for it in his *Pulse of Asia* and other writings, that Central Asia was once less arid than at present. Lastly, prehistoric remains of one sort or another had been found practically all around the outer borders of Mongolia, and the members of the Third Asiatic Expedi-











AN EXAMPLE OF POTTERY AND VARIOUS TYPES OF ARTIFACTS MADE BY THE DUNE DWELLERS OF THE GOBI



MR. NELSON MAKING THE PRELIMINARY CLASSIFICATION ACCORDING TO FORM

MR. NELSON MAKING THE PRELIMINARY CLASSIFICATION ACCORDING TO FORM



tion, 1922-23, had actually brought out some bits of flints and a fragment of pottery from distant parts of the Gobi itself—not much, but enough to indicate that early man had been there at least in late Stone Age times. Nevertheless, as we climbed over the Mongolian Pass above Kalgan on April 17 and headed into a cold and blinding sandstorm, the prospects looked none too encouraging.

But after clouds comes the sunshine. Once we were away from books and from the effeminizing comforts of civilization, the new environment laid firm hold on us and all fears and doubts vanished. As luck would have it our first night's camp, about one hundred miles from Kalgan, became an enforced stopping place, and we had time to look about for nearly a week. Immediately after breakfast on the first morning, Doctor Chaney, the botanist, and I set out on a tramp across the rolling hill country toward some high rock exposures in the distance, and by ten o'clock I had found my first man-made flint flake! It was a very modest and incomplete specimen, a little weather-beaten and all that, but I wouldn't have exchanged it for a kingdom. There were doubters in camp, of course, who said it had been made by the present inhabitants, the Mongols; but after I had asked some of the visiting natives to show me their strike-a-light flints, I was only the more convinced of the genuineness of my find.

Search as I might, however, I could not discover a second specimen. The finest of white quartz veins cropped out of the high hills, and flakes of all descriptions lay thickly strewn in places—some of them even resembled in form certain well-known Palæolithic implements, and in any case

were sharp and perfectly serviceable as tools. None of them, however, showed marks either of human workmanship or of utilization. It was not until we reached our third camp, some 225 miles from Kalgan, that we had a complete confirmation of the validity of our first discovery. Here, Mr. Shackelford, the staff photographer, obtained, two feet below the surface in a vertical gully bank, several cores and flakes of flint and also a number of bits of broken pottery—all unquestionably of Neolithic date.

From this point onward, clear across the Gobi proper and as far into the Altai region as the main Expedition penetrated, we found numerous traces of chipped stone artifacts. This was done at first only by intensive searching of the barren pebbly surface, but as we advanced northwestwardly, the evidence steadily increased both in quantity and in definiteness of character. In one place, some 730 miles from Kalgan, on a high plain lying between the Artza Bogdo mountains and the Ulan Nor (Red Lake), worked reject specimens of considerable variety lay scattered in such abundance that one could scarcely avoid stepping on them. This rich belt was about twenty miles wide and marked a locality where a fine quality of red jasper, especially suitable for the production of chipped tools and weapons, was weathering out of the underlying volcanic formation. Raw material in the form of boulders and pebbles, having thus been continually renewing itself in inexhaustible quantities, the locality may readily be supposed to have been a main source of supply for primitive man since his first coming into the region. At any rate, with that possibility in mind, a lengthy search was instituted, in which several members of the Expedition took





The dunes of Shabarakh Usu



A nearer view showing dunes redisectioned by stream and wind



Andrews, Nelson, and Young investigating the site where the Dune Dwellers camped in Stone Age times



Implements found embedded in the sand dunes

part, in particular Doctor Morris; but no forms of implements recognizable as of Early Palæolithic type were discovered. The oldest and most primitive forms found included certain pointed flakes and chipped side-scrapers very similar to those of the Mousterian culture in western Europe. Elsewhere, some 900 miles from Kalgan we found, also on the surface, a remarkable form of end-scraper closely resembling the grattoir of Aurignacian and Magdalenian times. The antiquity of our specimens is moreover vouched for by their relatively worn and weathered condition.

These surface finds, numerous and interesting as they were, could not, of course, be regarded as entirely adequate scientific data. They were, in fact, little more than good indications that early man had been about from time to time, his presence extending over a period comprising, doubtless, many thousands of years. Accordingly, we kept a sharp lookout for the occurrence of good geologic exposures of Pleistocene and later dates—hoping we might discover evidences of human occupation actually in place at some depth in these formations. In this quest we ultimately succeeded at some seven or eight localities, the best of them ranging from 700 to 900 miles northwest of Kalgan.

The first and most important of these sites was at Shabarakh Usu, a place already made famous by its remarkable yield of dinosaur eggs; and our last discovery was made in the basin of the Orok Nor, a large sheet of water situated at the north base of the beautiful snow-covered Ihke Bogdo Mountains.

As it turned out, we did not succeed for certain in finding any Palæolithic implements actually imbedded at some depth in formations of Pleistocene age.

We did, however, find specimens of the desired type on the surface of such deposits and under conditions which led us to suspect they had weathered out of the same.

Our principal discoveries, comprising artifacts of Mesolithic and Neolithic characteristics, were made in dune formations, probably of early post-glacial age. At any rate, these sometimes extensive wind-blown accumulations, sufficiently hardened by age to support vertical escarpments nearly thirty feet high, occurred with such regularity in the various basins and hollows, great and small, as to suggest their formation having taken place under climatic circumstances decidedly different from those of the present day. Judged by the conditions under which sand dunes are now occasionally forming in the region, these ancient deposits were piled up at a time when their respective basins held bodies of water, from the lee shores of which the dune material was principally derived. Today most of the basins are dry or nearly so, and their dune deposits are all "dead," so to speak, and as a rule in process of being removed at a slow rate by the strong, steady northwest winds. On the other hand, in the basins where lakes are still present, there the dunes are "alive" and continually piling up, sometimes into proportions of surprising grandeur and beauty.

Archæological interest attaches only to the old dead sand dunes which are slowly being eroded away. The winds doing this work blow, as stated, from the northwest. The result is that the ancient dunes today present, on the west or northwest, a series of parallel more or less high promontory escarpments, separated by valleys marking the places where most of the indurated or solidified dune material has been



Good hunting: the archæologist bags his game

scooped out. It was on the floor of these valleys that various members of the Expedition first discovered a great abundance of archæological objects: a moderate number of chipped stone tools and weapons, ground and polished stone tools and household gear, broken pottery, beads and pendants of shell, and, finally, untold numbers of mere rejects or waste specimens—all mixed together as the sandstone matrix in which they had been imbedded was gradually blown away. That this was the real origin of these surface pieces was proved before the end of the first day by examination of the walls of the adjoining promontory escarpments, in which flints, pottery, animal bones, etc. were found to occur in a distinctly stratified order.

The occasion of our first day's

archæological discoveries at Shabarakh Usu will probably long be remembered by several members of the Expedition; but the event cannot be described in greater detail at present. It must suffice to say, in conclusion, that during late pre-Neolithic and Neolithic times man lived and worked here, probably near the shores of a small lake, and that the sands blown from its shores slowly accumulated about his rude shelters and ultimately piled up to a height of at least forty feet. This under certain conditions might have happened in a very short time, but the artifact remains imbedded in the sands show that the time was long enough for the culture to change from a phase strongly resembling the Azilian of western Europe to one of out and out Neolithic characteristics.



Fig. 1. Wound in the skull of a cave bear (*Ursus spelaeus*) from the Drachenhöhle.—The wound, made by a sharp stone weapon, never fully healed but ulcerated until the time of death. The basilar length of this skull is 45 cm. (17.7 inches). In the fireplaces of Neanderthal man, 1060 feet from the entrance of the cave, we found another skull with a fresh wound in the region of the muzzle. In all probability a blow on the muzzle would cause immediate death, while a blow on the forehead or above the eyes would not necessarily be mortal, and the animal might be able to escape. Even to this day the Slovaks of the Carpathian Mountains kill brown bears by a powerful blow on the muzzle

## How Neanderthal Man Hunted Cave Bears

IN THE DRAGON'S CAVE NEAR MIXNITZ, AUSTRIA

By OTHENIO ABEL

**A**MONG the numerous fossil-bearing caves in Austria the Drachenhöhle or "Dragon's Cave" in Rötelsstein Mountain on the Mur River in Styria, is today among those best known.<sup>1</sup> This cave is more than 1800 feet long. The entrance is 3110 feet and the farther end 3280 feet above sea level. It is divided into three sections by two great heaps of stones fallen from the roof, which walled in enormous masses of fossilized bats' guano—or, as I named it, "chir-

opterite." A third heap of great blocks in the innermost section of the cave is older than the other two stonefalls. As Dr. Josef Schadler and I have shown, it occurred in Pliocene times, while the others fell during the Great Ice Age.

The first heap of stones formed an obstruction behind which there accumulated a great mass of bats' guano containing many hundred thousand fossil bones, chiefly of cave bear (*Ursus spelaeus*). In the basal layers we found bones of *Ursus deningeri*, a form ancestral to the later true cave bears. In the middle layers remains of the true cave bear (*Ursus spelaeus*) were very abundant and showed widely differing variations affecting nearly all parts of the skeleton, but especially the skull and dentition. It was in these layers

<sup>1</sup>The excavations in the Drachenhöhle were made in 1920-23 to secure the fossilized bats' guano or "chiropterite" for agricultural purposes, for after the war Austria had neither natural nor artificial fertilizer. These excavations, under the superintendence of Dr. Josef Schadler, yielded about 2360 tons of chiropterite, containing, on an average, 13 per cent P<sub>2</sub>O<sub>5</sub>. I was placed in charge of the scientific investigations. In addition to numerous preliminary reports, chiefly published in the *Anzeiger* of the Academy of Sciences, Vienna (23 papers), the scientific staff employed in the Drachenhöhle excavations has prepared a monograph in three volumes which is already in press and will appear shortly. The illustrations accompanying this article are taken from the monograph.



that the cave bears of Mixnitz reached their maximum of size and variability, while in the higher layers of the chiropterit the cave bear was represented chiefly by degenerate pigmy forms, the latest evolutionary stage of the Mixnitz cave bear before extinction. We collected, therefore, in the Drachenhöhle near Mixnitz data for the phylogeny of the cave bear that were unusually complete and very instructive.

But man's first visit to the cave is recorded from a much earlier time, that is, during the Great Ice Age, and especially in its last interglacial period, the time when the cave bear flourished. At this time, and in this region of the Alps, Neanderthal man hunted the cave bear even into the farthest recesses of this cave. In the spring of 1921, while we were excavating just in front of the second stone barrier 1060 feet from the



Fig. 2. Inscription on a rock in the Drachenhöhle, dated 1418.—At the top is the date in old characters; below, at the left, a heraldic sign; at the right, "Cholomanus"; third line, "halbe." in mediæval times the Drachenhöhle was already well known, and was visited by priests and nobles of the country. It was long believed to be a haunt of giants and dragons, as well as of the fabulous unicorn. Even as late as the first half of the nineteenth century the abundant remains of cave bears—supposed to be those of unicorns—were still being dug out and used for medicinal purposes

From early mediæval times, and even as late as the end of the eighteenth century, the Drachenhöhle was reputed to be a haunt of giants and dragons. Inscriptions on rocks and on the walls of the cave—the earliest date being 1386—tell of repeated excursions to this "wonder of nature." In olden times visitors marvelled at the numerous fascinating skulls and leg-bones of the giant cave bears, believing them to be the remains of giants or dragons, and thus the name "Drachenhöhle" or "Dragon's Cave" originated.

entrance, we uncovered two fireplaces of Neanderthal man, one above the other. Both were paved with flat limestone slabs and strewn with a great number of broken and burned bones of cave bear, together with pieces of charcoal, and a number of flakes and very primitive artifacts of Mousterian type, which were nearly all made of quartzite brought from the gravels at the bottom of the Mur valley to the cave, 1640 feet above the level of the river.

These fireplaces were situated at the opening of a narrow passage—the



Fig. 3. An excavation party in the Drachenhöhle.—From left to right, sitting: Dr. Wilhelm Marinelli, Prof. Othenio Abel, and Dr. Kurt Ehrenberg. Standing: Dr. Franz Spillmann and Dr. Otto Antonius. By January, 1921, the "Abelgang" had been completely excavated. The material removed contained thirty skulls, numerous lower jaws, and other bones of cave bears, and also the remains of wolves, lions, and smaller mammals.

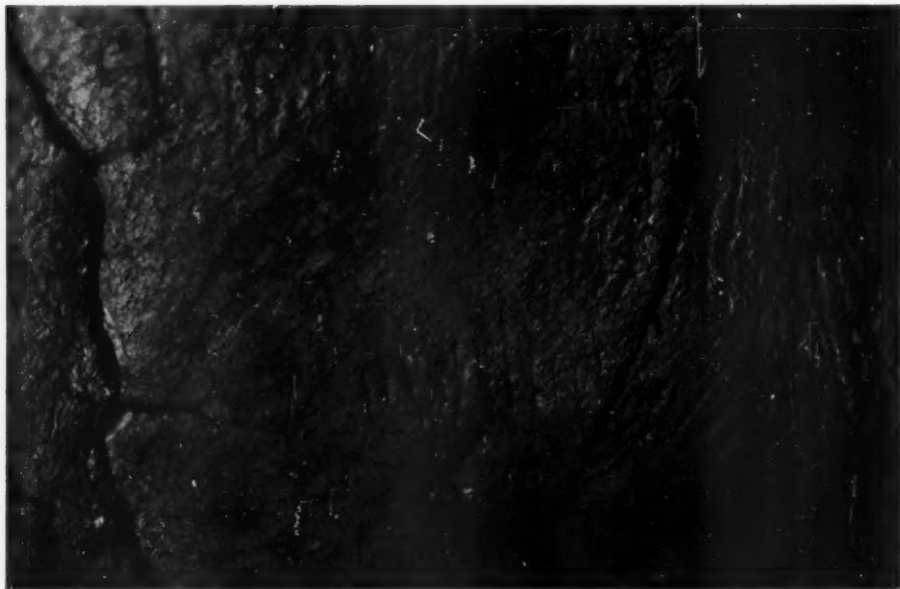


Fig. 4. Scratches made by cave bears on the walls of the Drachenhöhle.—The walls of the Drachenhöhle which are a Palaeozoic limestone, have been much decomposed by bats' guano, and their surface has been transformed into a soft phosphoric mineral. On this soft surface, in a narrow passage between the wall and a great stone block we found hundreds of claw marks made by cave bears. As Freiherr von Bachofen points out, Neanderthal men must have hunted the cave bears here chiefly by means of the *battue*, and doubtless attacked them suddenly in this narrow defile. The bears, in trying to escape, made these numerous marks on the wall

usual route of the cave bears which hibernated in the warmest (e. g., the innermost) part of the cave. After the chiropterite had been removed, Freiherr A. von Bachofen-Echt followed this path of the cave bears for a distance of about 820 feet from the fireplaces to the end of the cave, and found that the only possible exit for the bears had been through this narrow defile. Here the Neanderthal hunters had stationed themselves, and tried to kill the escaping animals by striking at them with long-handled clubs at the end of which sharp stones were fastened. This accounts for the numerous wounds on the skulls of the cave bears in the Drachenhöhle, later healed if the animals escaped, and always situated on the left side of the skull or lower jaw, that is, just on the side exposed to the hunters' attack when the bears ran along the narrow passage.

In January, 1921, we excavated a little side recess of the cave near the fireplaces, which was filled with a number of skulls and other skeletal remains, chiefly of cave bears. In a space not exceeding two or three cubic meters in extent we recovered thirty skulls, some of them with lower jaws *in situ*, together with many isolated lower jaws and numerous other bones.

It was a remarkable fact that these bones showed a rather peculiar arrangement. We found that almost all the bones at the bottom were small—chiefly metapodials and vertebrae; at a



Fig. 5. Accumulation of cave-bear skulls in the "Abelgang," a side recess in the Drachenhöhle.—Although the "chiropterite" contained an enormous number of bones and teeth of the cave bear, it was only in this recess that we found the skulls lying side by side. This photograph was made shortly after we began excavating, and shows eighteen skulls *in situ*.



Fig. 6. Rock polished by the fur of the cave bears.—The animals found their way in total darkness, chiefly by the sense of smell, along the walls of the cave and between the great blocks of stone fallen from the roof. In the course of time the edges and corners of these blocks and of the walls were worn smooth by the fur of the cave bears, as they rubbed against the rock.

higher level arm-bones and leg-bones predominated; then came a great series of pelvic bones; and the uppermost layer was composed chiefly of skulls and jaws. Some of the bones were badly rolled, or weathered, or

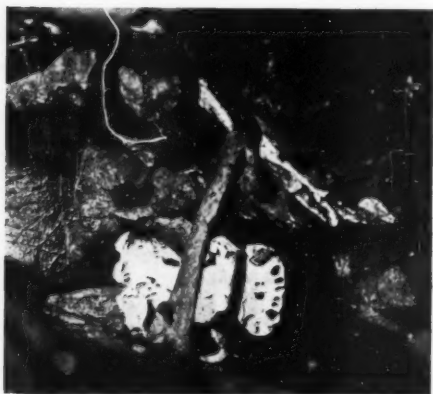


Fig. 7. Arrangement of the skull and ulna of a cave bear, believed to be the work of Neanderthal man.—In March, 1923, Dr. Josef Schädler found the skull and ulna of a cave bear firmly fixed in the deep marginal fissure between the wall and the floor of the Drachenhöhle. All the circumstances make it most improbable that this could have happened as the result of a fall, or of the action of running water, or of any other operation of the forces of nature

gnawed by wolves; others were broken before fossilization, and one skull showed a healed wound on the left frontal, made by the sharp stone weapon of some Neanderthal hunter.

The question was whether the peculiar arrangement of the bones at this site was artificial (e. g., made by Neanderthal man), or whether it was caused by the action of running water, separating the bones according to their weight, and accumulating them in this pocket or recess, without any human intervention.

The first explanation would be in accord with the observations of Emil Bächler in the "Drachenloch ob Vättis

im Taminatale," Switzerland, and also with the similar observations of K. Hoermann in the cave of Petershöhle near Velden, Franconia, Germany. In the Drachenloch near Vättis, 8020 feet above sea level, Neanderthal man buried skulls of cave bear with the adjoining vertebrae in stone chests and covered these with stone slabs. In Petershöhle the skulls and other bones of cave bears were not so regularly arranged as in the Drachenloch, but were irregularly piled in a little recess of the cave.

It is noteworthy that the primitive bear-hunting peoples of northeast Asia—Giljaks and Ainus—observe a peculiar religious veneration towards the skulls of the bears killed by them. It is not impossible that the accumulations of skulls and other skeletal parts of the cave bear in so small an area (eighteen skulls in a space of two square meters) in the Drachenhöhle near Mixnitz may be explained in the same way as the very similar accumulations in the Drachenloch and in Petershöhle.

Dr. Kurt Ehrenberg, who studied this matter together with other features bearing upon the whole problem of fossilization in the Drachenhöhle, is inclined to adopt my earlier viewpoint of 1921, namely, that the whole arrangement of the fossil remains in the recess is due only to the action of running water. On the other hand, he suggests that a curious combination of a bear skull with an ulna may be an instance of the deliberate arrangement of skeletal parts of cave bears by Neanderthal man, similar to the combination of skull and femur in the Drachenloch observed and described by Doctor Bächler in 1921.

# The Antiquity of Man in America

By PLINY E. GODDARD

Curator of Ethnology, American Museum

WHEN Columbus arrived in the New World in 1492, he was met by men, inhabitants of America. How long had they been here? There has been much speculation in regard to this question, but not much certain information.

For a time it was a favorite theory that the Indians were the descendants of the ten lost tribes of Israel. When the Indians came to be studied, however, it was found that instead of having a single language related to Hebrew, they possessed hundreds of languages which fall into many groups unrelated to each other. While a few of their practices do resemble those mentioned in the Old Testament, on the whole their customs are peculiar to themselves but with great differences as one passes from tribe to tribe. It is now the accepted opinion that when they came to America they had no domesticated animals except the dog, and no agriculture. They were ignorant of metals but were advanced in stonework. Wherever the remains of man are found, polished stonework appears among them. It is said, therefore, that they came during the Neolithic period. It is only in western Europe that the successive periods of stone art are known, and there the Neolithic is fairly recent, later than the last great glaciation, presumably not more than 25,000 years ago. While it is usually not definitely so stated, it is ordinarily assumed that this date holds everywhere.

Authorities have talked of 10,000 years ago as about the time when men may have crossed Bering Strait, and begun their long march to Patagonia.

In America the last ice cap came down as far as Northern New Jersey, over the greater part of Ohio, and covered Nebraska. The beginning of the retreat is estimated at 30,000 years ago, but this retreat was very slow indeed, and did not end earlier than 10,000 years ago. It is for this reason presumably that 10,000 years has been mentioned as the time when men came to America.

There are some reasons, however, for thinking the time must have been longer. According to the old theory, after crossing to America by way of Bering Strait in the north, the Indians moved southward, made their way down the Isthmus of Panama, and peopled all of South America as well as North America. Some time later they began to cultivate maize which was presumably a plant native to Central America. Maize under cultivation has changed its habit of growth so that it can no longer plant itself, but must be tended by man. In connection with its culture extensive irrigation grew up. After that cities and temples were built, and the higher civilizations of Peru, Mexico, and our own Southwest developed. All of this required time. One would be rash to say it could not happen in 10,000 years, but even more rash to say it did happen in that length of time.

Still more convincing is the linguistic differentiation. North of Mexico there are some fifty linguistic stocks or families, that is, fifty languages or groups of languages, so distinct from one another in their vocabularies, that no relationship can



be traced. There are many more such families of languages in Mexico, Central America, and South America. There are two theories which might account for such diversity. A people with a single language may have come to America, and remained here so long that wherever a group became isolated its language came to show no relationship to any others, so completely did it become changed. The second theory is that wave after wave of migrating peoples came across, each with a different language, but leaving behind them in Asia no remnants who preserved the language.

The growth of civilization in America and the linguistic differentiation, are strong arguments that America has been occupied by man during a very long period.

The geologists have a way of determining time, but over vast periods. They find one kind of rock on top of another kind and know that certain of them were laid down under water. The palaeontologists examining these strata of rock find fossils in them and know that certain forms of life followed certain other forms. They know that during the Ice Age or the Pleistocene, as they call it, certain large mammals were in America. Among these were horses much like those we know, camels, the bison, and the mammoth. They know this because they find the bones and teeth of these animals embedded in gravels and clays, which were laid down during the glacial period. If man's bones were found mingled with these, we would be certain man was also here at that time. Of the animals mentioned above, the horse and camel became extinct in about the middle of the Ice Age. But objects made by man have been found in the gravels and sands along the

southern boundary of the ice cap, particularly at Trenton, New Jersey, and in Ohio. Rather than accept these finds as evidence that man was here at the end of the glacial period, it has been assumed either that some mistake was made, or that somehow the object became embedded accidentally where it was found.

From time to time various objects have been found which either resemble an elephant in shape, or on which an elephant had been drawn. These have been presented as evidences that those who made these objects had seen elephants before they became extinct. In practically every case either the resemblance to an elephant has been denied, or fraud has been charged.

Two recent discoveries have changed the situation.

Professor Loomis has found objects, made by man, side by side and underneath the remains of mastodons and mammoths in Florida. Man then was in Florida before the elephants disappeared from this continent. The evidence presented puts the time after, but immediately after, the end of the Ice Age. There was of course no ice cap in Florida, but from earth movements, and the animals found just below the stratum which contains the bones of both men and elephants, the time is fixed.

Mr. Harold J. Cook in *Science* for November 20, 1925, pages 459-60, announced the discovery of three worked flints under the fossilized skeleton of a bison of an extinct species. The conditions under which the remains were found are given by Mr. Cook as follows:

The bison and other fossils occur in solidly cemented gravels, overlain by about five to seven feet of undisturbed Pleistocene sands and gravels, that are cemented so hard by calcareous cement that the beds are worked

with difficulty, especially when dry. On top of these sands is a disturbed bed of uncertain age, and above this several feet of worked-over sands, silts and soil. The bones found are all well fossilized, and in a state that it would be utterly impossible for erosion to have moved them, without breaking them up and disarticulating the bones, and largely destroying them. Every observed condition clearly points to an undisturbed deposit, and free from such cross-channeling as has worked the materials over at Vero, Florida. The bison pertains to one of the earliest stages of the refilling process in laying down these Pleistocene gravels and is just above the old Triassic floor. It is probable that the bison had been shot and carried these flint points with him to the place where he finally died and was entombed.

Not only is the evidence in this case entirely convincing since the finds were made by Museum men and the formations checked by a competent scientist, but there is the corroboration of an earlier find of the same nature. In 1895 two assistants in the department of palæontology of the University of Kansas found an arrowhead under the right scapula of an extinct species of bison, *Bison occidentalis* Lucas. This find was in Logan County, Kansas, and the formation was identified as Equus Beds of the Pleistocene. In these two cases of extinct bison which had been hunted, if not killed by man, the locations are beyond the region covered by the ice of the last glaciation, so that the determination of the age depends in part upon the presence of the remains of animals supposed to be confined to the Pleistocene.

Even if these animals lingered later in Texas and Florida we must assume that men were in America at the end of the Ice Age, or about 25,000 years ago. They have been here long enough to build civilizations, and for profound linguistic changes to take place. Furthermore, they appear to have been more advanced in their arts than were men in Europe at that time.

That men were here long before is possible. Fossil remains of man have come to light in Lower California and South America which appear to belong to a race very different from the present-day Indians. The evidence in these cases is not such as to settle all doubts, but it is strong enough to create interest and should stimulate further search. The regions most favorable for early man, the uplands of the tropics, have received little attention from field archaeologists interested in early man. The prime interest in Mexico, Central America, and the west coast of South America has been in the more recent high civilizations.

Students familiar with European prehistory say that if man were here during Pleistocene times the evidence should be abundant as it is in France and Spain. Let them beware of making the well-known region, western Europe, the standard for the entire world. Preconceptions and generalization based on one region are fatal to the open-mindedness necessary for progress in science.



# Early Man in Florida

By F. B. LOOMIS

Department of Geology, Amherst College

**I**N 1916 Sellards announced the finding of human bones and implements at Vero, Florida, in layers of sand containing the bones of extinct animals, such as the mastodon, mammoth, camel, horse, and tapir. These animals were at once recognized as an assemblage of forms which lived over wide areas of North America in the early Ice Age, a period lasting from about 1,000,000 years ago, to about 25,000 years ago. In North America the horse, camel, and tapir became extinct by the middle of the Ice Age, while the mastodon and mammoth lived on to the end of the Ice Age and a short time thereafter.

Three possible explanations for the presence of the human bones suggest themselves.

(1) The human bones were the remains of a burial or were deposited in these beds by some other artificial means, and were thus mingled with the bones of extinct animals, in which case the find is of little moment.

(2) The human bones were deposited with the sand by natural processes and were as old as the associated extinct animals, in which case man was in America in middle glacial times or about 500,000 years ago.

(3) The above-mentioned animals for some unknown reason lived to a later date in Florida than elsewhere, in which case the human remains could be of any date postulated for the prolongation of the life of this fauna in Florida.

In 1913 a similar find was made at Melbourne, Florida, about forty miles north of Vero. With the foregoing in mind an expedition under the auspices

of Amherst College and the Smithsonian Institution went to Florida and spent six weeks or more of the summer of 1925 in an effort to solve the problem. The expedition collected widely both at Melbourne and at Vero.

It is necessary, when collecting in this part of the country to determine, first, where the former drainage of the country had been situated. This is done, in large part, by following the banks of the modern drainage canals and watching for fragments of bones which may have been thrown out by the dredge in digging the canal. Where they occur the canal has crossed a former stream valley, which can be traced from that point a considerable distance. Much of this work had already been done for the party by Mr. C. P. Singleton, who has become very expert in finding the fossil bones. When an old stream valley is located, a pit is dug at random. If bones appear, the pit is enlarged, otherwise it is filled in. The bones may appear at about three feet below the surface, and occur from that level to the bottom of the river deposits, which may continue downward from one to five feet farther, the bottom being indicated by a layer of marine shells or coquina. Negroes were employed to remove the upper layer, and when they came to the bone layers, the representatives of the two institutions took up the work.

In four localities, each isolated from the other by at least a mile, either human bones or tools were found. Three of these were near Melbourne, the fourth near Vero, close to where Sellards had worked. One find was a human skull, crushed flat, together



Upper picture: View of a drainage canal and the excavation near it, in which was found the human skull.

Lower picture: The human skull just before it was bandaged. The arrow points to the skull. Above it is No. 3 layer, below is No. 2 layer

with a part of the arm. Another find was a large flint implement such as is usually called a spear head. The third, near Melbourne, was a smaller flint implement, together with a large number of flint chips and some bits of pottery. The character of the flint implements and the fact that pottery was found give the finds a modern appearance. The possibility of the overlying beds having been disturbed was kept in mind, and special care was taken to extend the work laterally

so as to unearth some of the extinct animals in the same layer with each find. The human remains were always overlaid by beds consisting of alternate layers of white sand and black vegetable matter, and it was easy to determine that the human remains had not been introduced into these beds at a later time.

We found three beds, as reported by Sellards, who numbered them from the bottom upward. No. 1 is the layer of marine shells or coquina and is

of marine origin. No. 2 is deposited on an irregularly eroded surface of No. 1. It consists of layers, often cross-bedded, of sand, usually brown in color, and without any layers of black vegetable matter. No. 3 lies on the irregularly eroded upper surface of No. 2. It consists of white sand, bedding in alternate bands with layers of black vegetable matter.

We found that all of the animals, horse, camel, tapir, etc., which are characteristic of the early Ice Age in America were confined to the lower of the two river deposits, i. e., bed No. 2. All of our finds of human material were in or at the base of the No. 3 bed, in which there were also numerous bones and teeth of mastodons and mammoths, not to mention deer, dogs, raccoons, etc. This modified the postulates made at the beginning of this article by confining the association of man with the elephants which did live to the end of the Ice Age and a little later. The problems then remaining were the age of bed No. 3, and how long the mammoth and mastodon lived after the Ice Age.

The character of these fresh-water beds also indicates certain oscillations in level of the Florida country. First, when the shell layer or coquina was laid down, Florida must have been below sea level. The shells indicate late Pliocene. Then it was elevated to at least forty or fifty feet above its present level, either in late Pliocene or earliest Ice Age, at which time a drainage system was developed, including such a river as the Indian River and its numerous tributaries. The next movement was a downward one to a level near that of the sea. As a result of this, the valleys of the streams, at least in their lower portions, were filled. The bones in the sand of this

fill (No. 2 bed) indicate that this took place in the earlier part of the Ice Age. A second elevation is indicated by the eroded upper surface of this No. 2 bed. Then a second downward movement is indicated by the No. 3 bed. While this No. 3 bed was forming, the bones of mastodons and mammoths were included in the material along with both human bones and tools. The whole question now hangs on when this last filling in took place. The only data which are now available are the bones of the mastodon and mammoth. At first thought one would say it must have been either in late Ice Age or very shortly after the Ice Age. The end of the Ice period is put at 25,000 years ago.

The only possibility of a later date than 15,000 to 20,000 years ago as a minimum, lies in the possibility of these elephants surviving in Florida to a later date than elsewhere. In these beds we are not dealing with a remnant of the elephant fauna. They occur in great numbers. Scarcely ten square feet can be uncovered without finding some part of an elephant bone. Usually less than a square yard is free from them. We found parts, teeth or limb bones, of no less than fifty elephants in our excavations which could not have covered more than two or three acres. The elephants were flourishing during the time that No. 3 bed was laid down. Much the same is true in other parts of the country. Just before they disappeared they were very abundant, then they were all gone, as though swept off by a pestilence. There is no reason to think they lasted longer in Florida than elsewhere. All this, then, would indicate that man of the Neolithic type of culture was in Florida 20,000 years ago at least.



# Why Central Asia?

By HENRY FAIRFIELD OSBORN

American Museum of Natural History

THE TRADITIONAL HOMELAND OF WESTERN ASIA—THE NORTHERN ASIA CENTER OF QUATREFAGES—THE CENTRAL ASIA THEORY OF MATTHEW—THE WESTERN EUROPE THEORY OF REINACH—AMERICAN MUSEUM EXPLORATION REVIVES THE CENTRAL ASIA THEORY—OSBORN SETS FORTH THE CLAIM OF MONGOLIA AND THE UPLAND ASIATIC ORIGIN OF TERTIARY MAN—ANDREWS AND NELSON STRENGTHEN THE CENTRAL ASIA THEORY—OUR TERTIARY ANCESTORS "DAWN MEN" RATHER THAN "APE MEN."

IN the history of western thought the traditional homeland of man is doubtless western Asia because of Biblical influence and because western knowledge barely extended beyond the confines of Asia Minor, Palestine, Syria, and Mesopotamia. As to eastern thought on this great subject we are assured that the Chinese believed that they sprang from their own soil, and as for the south Asiatics, they concerned themselves little about the geography of human origin.

## THE NORTH ASIATIC THEORY

With the beginning of the science of anthropology in France there arose—from the scientific viewpoint—the question of the region in which mankind originated, which is brilliantly discussed by Quatrefages in the fifth chapter of his great treatise, *Histoire générale des Races humaines* (1889), where he handles the specific problem of the 'Origine géographique de l'espèce humaine.' After combating the idea of 'autochthonism'—the springing up of various ancestors of the human race in scattered areas of the earth's surface—and after dismissing the related speculations on 'polygenism' or the independent origin of human species and races, he finally comes to the serious consideration of what he terms 'centres d'apparition' and turns his glance toward the great northern plains of central Asia. He refers with approval

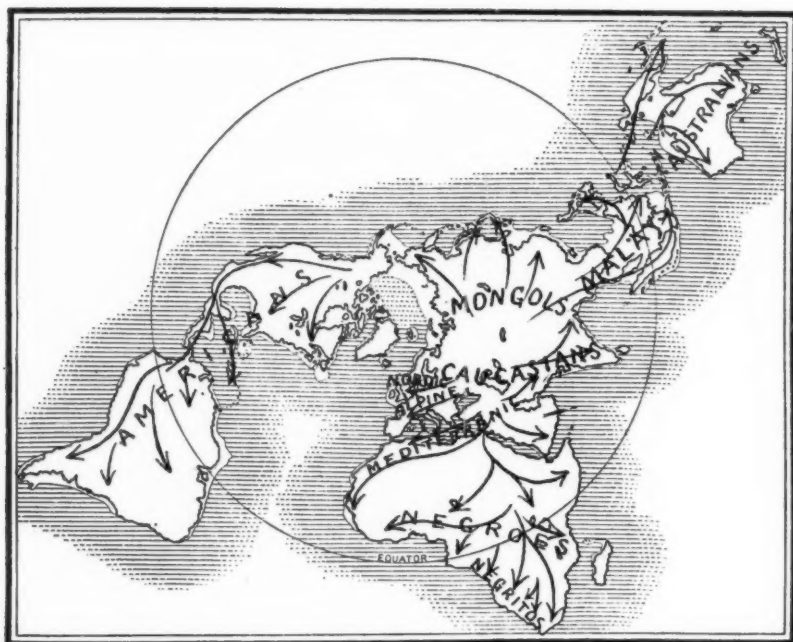
to Nordenskjöld's theory which places the Eskimos among the most ancient races of mankind, and then describes the theoretic southward migration of primitive tribes enforced by the rigors of the great northern glaciation, as follows:

Marchant surtout vers le soleil, elles rencontrèrent le massif central et ses dépendances. Elles s'arrêtèrent longtemps dans ces contrées; elles y virent l'aurore des temps qui ont succédé à l'époque glaciaire; elles s'y mêlèrent ou se juxtaposèrent à celles de leurs soeurs qui les avaient précédées. Au coeur et tout autour de ce grand massif, les conditions d'existence étaient loin d'être les mêmes. Le milieu fit son oeuvre; et cette région devint ainsi, non pas le centre d'apparition de l'espèce, mais le centre de formation, ou de caractérisation des types ethniques fondamentaux de l'époque actuelle.

At the opening of Chapter VI he describes the peopling of the globe through migration from a north Asiatic center as follows:

L'espèce humaine, primitivement cantonnée dans un centre d'apparition unique et peu étendu, situé vers le nord de l'Asie, est aujourd'hui partout. Elle s'est donc répandue de proche en proche, en marchant en tout sens. Le peuplement du globe par migrations est la conséquence forcée des faits précédemment exposés. Les polygénistes, les partisans de l'autochtonisme ne pouvaient accepter cette conclusion. Aussi ont-ils nié ces migrations.

This theory of a north Asiatic center—defended as it was by the allusions of Quatrefages to a supposed northern influence on Palæolithic art—and of a dispersal along lines of migra-



Dispersal and distribution of the principal races of man. No attempt is made to indicate anything beyond the broader lines of dispersal. From Matthew's *Climate and Evolution*, Page 210, 1915

tion southward, eastward, and westward, is however quite distinct from the theory of central Asiatic origin advocated by Dr. William D. Matthew in his very able address on "Climate and Evolution" before the New York Academy of Sciences, February 13, 1911, in which he sums up the evidence for the origin and dispersal of mankind, as follows:

We may with advantage begin our review of the special evidence in support of our theory with the migration history of man. This is the most recent great migration; it has profoundly affected zoögeographic conditions; it is the one where our data are most complete and accurate; we can perceive its causes and conditions most clearly, and we have a great deal of corroborative evidence in history and tradition.

All authorities are today agreed in placing the center of dispersal of the human race in Asia. Its more exact location may be differently interpreted, but the consensus of modern

opinion would place it probably in or about the great plateau of central Asia. In this region, now barren and sparsely inhabited, are the remains of civilizations perhaps more ancient than any of which we have record. Immediately around its borders lie the regions of the earliest recorded civilizations—of Chaldea, Asia Minor, and Egypt to the westward, of India to the south, of China to the east. From this region came the successive invasions which overflowed Europe in prehistoric, classical, and mediæval times, each tribe pressing on the borders of those beyond it and in its turn being pressed on from behind. The whole history of India is similar—of successive invasions pouring down from the north. In the Chinese Empire, the invasions come from the west. In North America, the course of migration was from Alaska, spreading fan-wise to the south and southeast and continuing down along the flanks of the Cordilleras to the farthest extremity of South America. Owing to the facilities for southward migration afforded by the great Cordilleran ranges, the most remote parts of the New World are the forests of Brazil and of north-

east South America. In the northern continent, Florida is the most distant from the source of migration.

Matthew's central Asiatic theory of human dispersal is clearly illustrated in his accompanying figure, which agrees with the general thesis maintained in "Climate and Evolution" that primitive races of man, as well as primitive races of mammals, are constantly being thrust out from the center of dispersal into the most remote terminal regions of the earth's surface, whereby, viewing the earth from the North Pole, we see a fringe of primitive peoples—Australians, Bushmen, Negritos, Tierra del Fuegians—thrust into peripheral regions as companions of primitive mammals such as the monotremes, marsupials, and insectivores.

#### HUMAN FOSSILS OF WESTERN EUROPE

Quatrefages' great work appeared in 1889. Only two years earlier, in the year 1887, the discovery of two Neanderthaloid skeletons at Spy, near Dinant, Belgium, confirmed the authenticity of the Neanderthal race of man and opened the way for a succession of discoveries of fossil human remains which reseeded the whole of western Europe with various races, species, and perhaps genera of primitive man, thereby accumulating fossil evidence strongly in favor of western Europe as a center of human dispersal.

Since the convincing proof both of the great antiquity and of the gradual ascent of man has been challenged, we may briefly state that the fossilized remains of no less than 116 individuals belonging to the Old Stone Age, or even earlier, have been found during the years 1823–1925.

Broadly classified according to races, they are as follows.

(3) Cro-Magnon and other races of Late Palaeolithic times, mostly narrow-

headed . . . remains of 74 individuals.

(2) Low-browed Neanderthal race (Gibraltar, La Chapelle, La Quina, La Ferrassie, Spy, Taubach, Ehringsdorf, etc.) including the ancestral form of Heidelberg . . . remains of 40 individuals.

(1) Piltdown race . . . remains of 2 individuals. (Possibly also a Foxhall race of Upper Pliocene times.)

The broad- and narrow-headed races of post-Palaeolithic or pre-Neolithic time are represented by the remains of at least 236 individuals, and far more abundant are the human remains of Neolithic age.

Meanwhile, during the same period of more than a century (1823–1925), only a single discovery of prehuman or human remains had been made in the whole continent of Asia, namely, the *Pithecanthropus* or Trinil ape-man of Java; and as discovery sites of fossil man gradually studded the entire map of western Europe, was not the suspicion a natural one that man originated not in Asia but in Europe? As Hrdlička observed in 1913:

Europe, particularly in its more western and southern portions, has thus far proved the richest in ancient human remains. Africa, Asia, and those parts of Oceanica which were formerly connected with the Asiatic continent have as yet been but little explored. The island of Java, however, which is within the last-named region, has furnished an intensely interesting specimen bearing on man's evolution and antiquity. As to America, the researches have thus far yielded nothing that could possibly be accepted as representing man of geological antiquity. For the present, therefore, an account of the very ancient remains of man, with the exception of the Java specimen, must be limited to early European forms.

In 1893 the distinguished French archæologist, Salomon Reinach, deeply impressed with the vigorous development of early civilizations in western

Europe during Neolithic times and throughout the early ages of metal, abandoned the generally accepted theory of an Asiatic origin of these industries as a "mirage oriental" and set forth with scholarly acumen the claims of western and northern Europe as an independent center of cultural dispersal during the Neolithic Age and the succeeding ages of Copper and of Bronze.

Although not unmindful of the weight of fossil and cultural evidence favoring the claims of Europe, the present writer never swerved from his Asiatic beliefs and stoutly maintained that we must nevertheless adhere to the older Asiatic theory as by far the more probable. Thus the problem of the center of human origin, whether Asiatic or European, became one to be settled only by exploration in Asia, no less extensive and no less intensive than that which led to the wonderful discoveries in western Europe between 1823 and 1925.

#### NEW EVIDENCE FOR CENTRAL ASIA

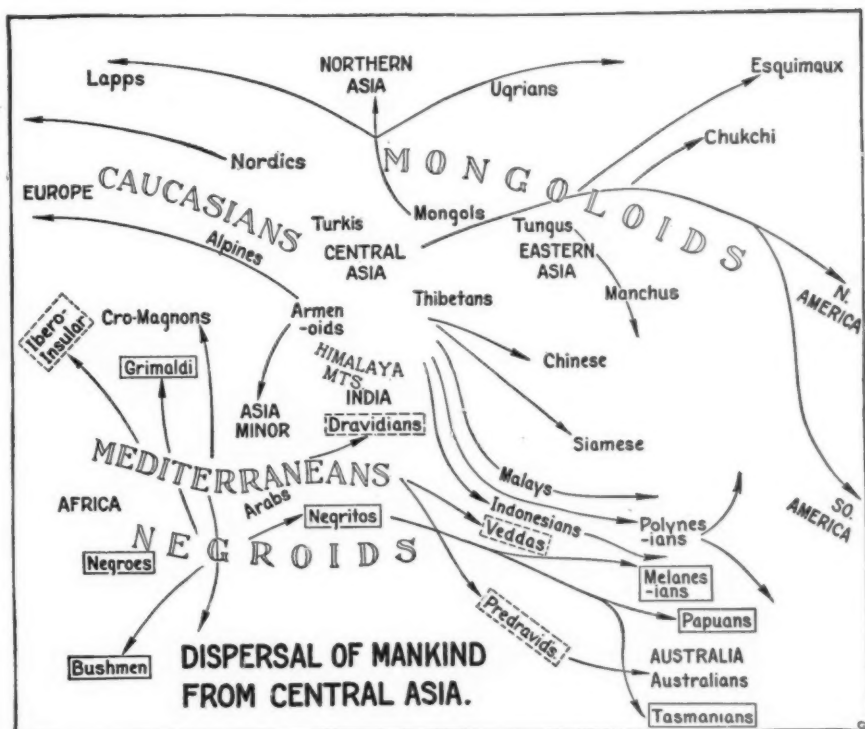
The hunt for fossil man in Asia was the slogan which enabled Roy Chapman Andrews to arouse a nation-wide interest in his great project of Mongolian exploration; no other appeal for financial backing was nearly as strong as this, and it finally enabled him to start his first expedition in the season of 1921. But the Andrews party was not destined immediately to attain its goal of fossil or cultural human remains. During the two entire seasons of 1922 and 1923 the party journeyed for 6000 miles, skirting the western region of the Gobi without finding a single trace of fossil man, although encouraged by the discovery of a new continental life, of a new theater of mammalian evolution, which stimulated renewed and more inten-

sive search for evidences of human occupation in the geologic past.

It was at the dramatic moment of the close of the season of 1923 when the discovery of the dinosaur eggs gave our expedition a world-wide fame, that the writer joined Andrews' party in the east central Gobi and began to visualize the life environment of Tertiary time as ideal for the early development of the dawn men or the direct ancestors of the human race.

This high plateau country of central Asia was partly open, partly forested, partly well-watered, partly arid and semi-desert. Game was plentiful and plant food scarce. The struggle for existence was severe and evoked all the inventive and resourceful faculties of man and encouraged him to the fashioning and use first of wooden and then of stone weapons for the chase. It compelled the Dawn Men—as we now prefer to call our ancestors of the Dawn Stone Age—to develop strength of limb to make long journeys on foot, strength of lungs for running, and quick vision and stealth for the chase. Their life in the open, exposed to the rigors of a severe climate, prompted the crude beginnings of architecture in their man-made shelters, and the early use of fire for bodily warmth and for the preparation of food.

This conception of the early development of man in a high plateau country accords with all principles of human evolution, and is well-established by observations in the Holocene or recent period of the Age of Man. In support of this view we may note: *First*: That the evolution of man is arrested or retrogressive in every region where the natural food supply is abundant and accessible without effort; in tropical and semi-tropical regions where natural food fruits abound, human effort—



Since remains approximately half a million years old, identified as those of man, have been found in England, in Germany, and in Java, it is apparent that early man was a great traveler. Did an ancestral race live in central Asia? Mongolia and Tibet are a favorable upland region for the beginning of man who is usually held to have originated in one place and branched widely. Figure by W. K. Gregory, 1924

individual and racial—immediately ceases. *Second*: That all precocious intelligence and early civilization in mankind were fostered in open regions where the food supply is scarce and impossible to obtain without individual effort and resourcefulness. The corollary of these two principles is the *third*: That during Tertiary times all the lowlands of Asia were relatively well forested and well watered, with a relatively accessible food supply—conditions altogether favorable not to man but to the continued development of the great anthropoid apes, as well as to the retention of arboreal or semi-arboreal habits of life. In brief, while the anthropoid apes were luxuriating

in the forested lowlands of Asia and Europe, the Dawn Men were evolving in the invigorating atmosphere of the relatively dry uplands.

#### MONGOLIA

This line of thought led to the writer's extemporaneous address delivered October 8, 1923, before the association of the Wen Yu Hui or 'Friends of Literature' on returning from the Mongolian plateau to Peking. This address, entitled "Why Mongolia May Be the Home of Primitive Man," expressed as logical the hope that fossil remains of the very earliest human beings may be found on the great Central Asiatic Plateau and perhaps in



Mongolia itself. It continued with the following argument:

Before and after cave times men lived mainly in the open, along the river-bottoms, or river-drift, or on the uplands or plateaus. Such a mode of life is conducive to the development of the finest physical and moral qualities of the race, for in the open, in intertribal competition, in resistance to and conquest of a natural environment, and in the opportunity for free migration lies the stimulus that carries man up the ladder of advancement. Life in the open preceded by 400,000 years the period of life in the caves, and when a race which has developed under the stimulating influence of an open, broad and varied environment is temporarily forced by the exigencies of the climate to seek shelter in the caves, its latent energy turns to new endeavors, its evolution follows a new direction. Such men are benefited spiritually and intellectually by a life in caves, for such a life of relative isolation turns them to reflection and to contemplation. Thus the period of cold and rigorous climate in Asia and Europe was one of vast importance in the spiritual and mental development of the race, just as the period of life in the open was one conducive to its physical and moral development.

\* \* \* \* \*

Thus the three fossil races, the Trinil, the Piltdown, and the Heidelberg, must themselves be distant descendants of an earlier ancestral race. Where did this race live and have its origin? This brings us to the question involved in the title of this address as announced, "Why Mongolia May Be the Home of Primitive Man." We observe that early man was not a forest-living animal, for in forested lands evolution of man is exceedingly slow, in fact there is retrogression, as plentifully evidenced in forest-living races of today. Those South American Indians who live in the forests are backward in development as compared with those living in the open. Of the latter, those living in uplands are more advanced than those living in the river-drifts.

Mongolia was probably not a densely forested country—this is indicated by the animal remains found there in the earlier deposits. An alert race cannot develop in a forest—a forested country can never be a center of radiation for man. Nor can the higher type of man develop in a lowland river-bottom country with plentiful food and luxu-

rian vegetation. It is upon the plateaus and relatively level uplands that life is most exacting and response to stimulus most beneficial. Mongolia always has been an upland country, through the Age of Mammals and before. It was probably a region forested only in part, mainly open, with exhilarating climate and with conditions sufficiently difficult to require healthy exertion in obtaining food supply. \* \* \* \* \*

In the uplands of Mongolia conditions of life were apparently ideal for the development of early man, and since all the evidence points to Asia as the place of origin of man, and to Mongolia and Tibet, the top of the world, as the most favorable geographic center in Asia for such an event, we may have hopes of finding the remote ancestors of man in this section of the country. However, this Mongolian idea must be treated only as an opinion, it is not yet a theory, but the opinion is sufficiently sound to warrant further extended investigation.

The first evidence in support of the writer's belief that man inhabited the high plateaus of Asia at a very early stage of his development was afforded by the great discovery of Père Teilhard de Chardin and Père Licent, who found deposits of Mousterian artifacts associated with the fossilized bones of animals at three different sites in the province of Ordos, northern China, in 1923. A full account of this by Père Teilhard de Chardin himself will be found in this issue of *NATURAL HISTORY*.

#### ANDREWS STRENGTHENS THE CENTRAL ASIA THEORY

Reinforced by a highly trained and experienced archæologist, Mr. Nels C. Nelson of the American Museum staff, the expedition of 1925 started out more determined than ever to secure either negative or positive evidence bearing on the Central Asiatic theory of human dispersal. The brilliant positive results are already known to readers of *NATURAL HISTORY* and to the world at large through cablegrams

and later reports from the leader of the expedition. The first cablegram dispatched by Mrs. Andrews announcing the discovery of the existence of fossil man in Mongolia in the closing phase of the Old Stone Age reads as follows:

11:48 P.M., PEKING, June 1, 1925.  
MUSEOLOGY, New York.

Roy wires Berkey continues well. Great success. Immediately discovered more dinosaur eggs and Late Palaeolithic culture corresponding European Azilian. Thousands flint artifacts. Work just begun.

ANDREWS.

This discovery is described by Mr. Nelson in his article in this issue entitled "Dune Dwellers of the Gobi." Subsequent discoveries included artifacts of Mousterian type, thus affording evidence of man's existence in the much earlier Mousterian industrial period which, in Europe, coincides with the dominance of the Neanderthal race. Indications of still earlier stone industries are found, which may belong to Acheulean times; and also possible indications of the Dawn Stone or Eolithic Age. The latest evidence in favor of Asia as the home of primitive man is supplied by Turville-Petre's surprising discovery (August, 1925) of a skull of Neanderthal type in Palestine—known as the 'Galilee' skull.

Considering these discoveries—all made in the brief period of three years (1923-25), and all pointing to the 'Mother of Continents' as the homeland of the human race—we are still compelled to urge caution against any hasty conclusions, and a renewed search for the still undiscovered Dawn Man of Tertiary times.

#### THE DAWN MAN

The descriptive term 'Dawn Man' is adapted from Smith Woodward's designation of the Piltdown race of

Sussex, England, as belonging to a genus, *anthropos*, distinct from the *Homo* of Linnæus. The term *Eoanthropus*, derived from the Greek *eos*, signifying dawn, and *anthropos*, man, is, to our mind, more in accord with modern discovery, which gives the human race a line of ancestors of its own, quite distinct from that of the anthropoid apes. Man and all his ancestors should now be embraced within the family *Hominidæ*, as distinguished from the family *Simiidæ*, which embraces all the anthropoid apes. This family distinction naturally carries with it the appellation 'Dawn Man,' as distinguished from the appellation 'ape man,' which will gradually disappear through disuse along with other misleading terms due to our misconceptions and ignorance as to the actual ancestors of man.

In this connection it is interesting to recall that the term 'ape' was first applied to lowly members of the order of *Primates* known to Aristotle and that it is the equivalent of the Greek word *Simia*, which signifies 'snub-nosed'; also to recall that 'ape' and 'simia' have been used from the time of the Greeks and Latins in terms of contempt. Consequently, it is doubly important to substitute the terms 'Dawn Man' and 'Dawn Men' for the terms 'ape man' and 'ape men'; first, because the latter terms can no longer be used truthfully and, second, because these terms bear with them more or less the idea of inferiority—inferiority which in our opinion is not deserved by the Dawn Man.

*We prophesy that the Dawn Man will be found in the high Asiatic plateau region and not in the forested lowlands of Asia, but many decades may ensue before this prophecy is either verified or disproved.*

# A Dissenting Opinion as to Dawn Men and Ape Men

By WILLIAM K. GREGORY<sup>1</sup> AND J. HOWARD MCGREGOR<sup>2</sup>

EDITORIAL NOTE.—To his honor it may be said that Professor Osborn has always welcomed and acknowledged honest criticism of his conclusions by his scientific associates. We therefore print the following note, commenting on Professor Osborn's views as to the distinction of the human and anthropoid families of Primates.

WE quite agree with Professor Osborn that even the earliest known races of mankind (*Pithecanthropus*, Piltown, etc.) were already true Hominidæ and therefore, in spite of certain ape-like features, they hardly deserved the name of "ape men." It is generally recognized that each of the modern anthropoid apes is specialized in certain peculiarities that definitely rule it out of the line of human ancestry. The known facts of palæontology also prove that these two families must have begun to diverge from each other at some period before the Lower Pleistocene, and we agree with Professor Osborn that the human family probably did have a line of ancestry of its own which stretched backward far into Tertiary times. It would also be convenient to call these Tertiary men "Dawn Men" if it be understood that *Eoanthropus* (Piltown), the one that was originally so named, was one of the latest of the series.

But from Professor Osborn's recent papers the general reader may very well mistakenly gain the impression that it is Professor Osborn's deliberate intention to disclaim for the human race all kinship whatever with the anthropoid apes and to assign man and all his ancestors to a superior line of beings which throughout the

whole of geological time preceding the late Pliocene had kept itself aloof from other vertebrates.

In earlier years Professor Osborn in a brilliant series of palæontological papers followed the lines of evolution of the dentition in many mammals. Turning to the fossil primates of the Eocene, he traced step by step the transformation of the upper molar teeth from a tritubercular to a quadritubercular type, and in other papers on the evolution of the human molar teeth he developed Cope's view that the quadritubercular human upper molar had been derived from the tritubercular type of primitive Primates. Developing further the methods and principles of Cope and Osborn, one of the present writers in various publications has shown how gradual is the transition, among the molar types of the numerous known fossil Primates, from the tritubercular upper molars of Eocene Primates to the quadritubercular upper molars of anthropoids and men.

These researches have also revealed with startling clearness the close resemblance in the pattern of the lower molar teeth between certain fossil anthropoid apes and the Dawn Man of Piltown, as shown elsewhere in this number of NATURAL HISTORY. In his admirable work *Men of the Old Stone Age* (1915, p. 51) Professor Osborn

<sup>1</sup>Professor of Vertebrate Palæontology, Columbia University; Curator, Department of Human and Comparative Anatomy, American Museum.

<sup>2</sup>Professor of Zoology, Columbia University; Research Associate in Human Anatomy, American Museum

says: "Among these fossil anthropoids, as well as among the four living forms, we discover no evidence of direct relationship to man but very strong evidence of descent from the same ancestral stock. These proofs of common ancestry, which have already been observed in the existing races of man, become far more conspicuous in the ancient Palæolithic races; in fact, we cannot interpret the anatomy of the men of the Old Stone Age without a survey of the principal characters of the existing anthropoid apes, the gibbon, the orang, the chimpanzee and the gorilla." With these conclusions the great majority of Professor Osborn's scientific colleagues remain, after the most intensive investigations, in hearty accord.

When Professor Osborn speaks of Central Asia as the homeland of the Dawn Men he obviously refers to the source of the later stages of human evolution, when according to his theory even the Dawn Men were already definitely men. But just as in the classical story the great king was reminded daily "*hominem memento te*," so even *Homo sapiens europæus* is not lacking in reminders of his lowly origin. He may well wear the cruciform pattern on his second lower molar, but his first molar still bears the mark of the *Dryopithecus*.<sup>1</sup> If the family of mankind has *always* been superior to the family of the anthropoids, why do

modern anthropoids and men, in spite of their widely diverse specializations still resemble each other so profoundly and in so many directions that even the "man in the street" recognizes the almost human qualities of his despised relatives? And why does the human foetus at a certain stage show such an unmistakable resemblance to the foetus of the gorilla and the chimpanzee in the hands and feet, eyes, ears, nose, lips, teeth, skull, skeleton, and brain?

In another part of this journal Dr. G. Elliot Smith, professor of anatomy at the University of London, states in substance that, so far as our present knowledge extends, there is no structure in the human brain which has not also been found in the brain of the anthropoid, and that the human brain surpasses the ape brain only in the quantitative development of certain parts. But if all the ancestors of man have always been superior to the apes, why are the brains of ape and man built upon a common plan and why are several stages in the apparent transformation of the lower into the higher type already known?

After many years of intensive investigation of the subject from various angles, the present writers can state as a fact that by every criterion used to estimate zoölogical relationships, including the data of anatomy, embryology, physiology and pathology, the chimpanzee and the gorilla stand closer to man than to any tailed monkey.

<sup>1</sup>See page 300





Fig. 1. The leaning statue "Watoe Langko" stands on a long low ridge near the village of Lamba, at the base of high mountains which surround the plain of Napoe. Note the hooks sculptured on its breast

## The Stone Images and Vats of Central Celebes<sup>1</sup>

By H. C. RAVEN

Associate Curator, Comparative and Human Anatomy

IN 1917 while passing through the village of Bamba in the district of Bada, Central Celebes, I chanced to see an interesting stone image standing among the bananas close to a native house. I photographed it and inquired of the natives concerning it. They informed me that it was an image of a woman named "Langke Boelawa" (Golden Anklet) who had turned to stone, and that the image until a few years before, when they brought it to its present position, had stood near the foot of the mountain on the northern side of the near-by Tawelia River.

Naturally I tried to find out by whom the image was made and if there were more like it about. My informants

told me nothing of importance concerning its origin, but they did tell me that I would be able to see images and other objects of stone in the districts of Besoa and Napoe, both of which I was on my way to visit.

I spent several weeks in Besoa and later in Napoe, studying and photographing all the stone objects in the vicinity. It was easy to reach the sites when guided by natives, but a visitor passing through the districts would certainly never have seen any of them, as they are located some distance from villages and from the main trails. In Besoa I saw an image somewhat similar to the one in Bada and a number of great vats, each hewn from a single

<sup>1</sup>The field notes and pictures for this article were made while the author was collecting natural-history material in the East Indies for the Smithsonian Institution, Washington.





Fig. 2. "Langke Boelawa," meaning Golden Anklet, is the name given by the natives of the Bada district to the legless granite image in the village of Bamba

piece of granite, some having ornamented covers, and a floor made of smooth flat pieces of stone. In Napoe were two stone images and one hollowed-out rock very unlike the vats of Besoa and crude in comparison, though its purpose may have been similar. The only other stone objects I saw in Central Celebes were mortars undoubtedly used in the pounding of grain, as the present inhabitants use

wooden mortars. These stone mortars, each consisting of two hemispherical hollows six or eight inches in diameter and a foot or more apart in the rock, the upper surface of which was levelled and smooth, were at Lemo in the Koelawi district. Another was located near the Lake of Lindoe.

From the village Doda in Besoa an old man guided me to Boeleli to show me the stone image there. Boeleli is a

low hill covered with long coarse grass and is close to the foot of the high mountain Toewo. Upon reaching the image my companion rode his horse close beside it and leaning over, wiped his hand first across the brow of the image and then across his own. He explained that he did this "to get strength from Tadoe Lakoe," as the image was called by the natives. "Tadoe Lakoe," it is said, was an ancient local war leader, and the natives believe the image to be the chieftain himself and not merely a representation of him. The statue (Fig. 13) stands about seven feet high, is about thirty inches wide, and is made from a single block of granite. The accompanying photographs, showing both front and side views, make detailed description unnecessary but it may be well to call attention to some of the characters which are not so clear, owing to the low relief in which they were executed: (1) the ears are represented by bumps high up on the sides of the head, their lower borders being about the level of the eyebrows; (2) the shoulders, arms, and hands are in low relief, the fingers pressed to the lower abdominal region; (3) the male generative organ in higher relief is upright and to be seen clearly in the profile; (4) the limit of the forehead is marked, evidence that headgear of some sort is represented. The stone of the top of the head, however, appears to be more or less weathered and this may account for part of the asymmetry.

The image in Besoa, "Tadoe Lakoe," on the evidence of the phallus alone represents a man. The image in Bada known as "Langke Boelawa" was said to represent a woman but there is no positive evidence for such a statement. The images in Bada and Besoa resemble each other closely in the

matter of the breasts, ears, headdress, and position of the hands, and perhaps in the phallus. The Napoe images (Figs. 1, 11) differ from those of Bada and Besoa in the apparent lack of headgear and the lack of arms and hands. A mouth is not shown in the figures of Bada and Besoa, but my photographs of the Napoe specimens appear to show in each case what may be a slight groove below the nose, suggesting a mouth. The placing of the ears in the Napoe specimens is lower on the sides of the head, thus more normal than in the figures of Bada and Besoa.

The first stone vats I found in Besoa were near the image "Tadoe Lakoe" where there were four or five together. The most interesting one (Fig. 17) was cracked and had more or less recently been turned on its side. It was of average size, about five feet in diameter by six in height, but its peculiar feature was a concave shelf about eight or ten inches wide inside the vat a few inches from the upper rim, as shown in the accompanying photograph and diagram (Figs. 5 and 17). Except for this shelf the inside of the vat was perfectly smooth and well worked, the outside somewhat weathered and less smooth on that account. The bottom of the vat outside was flat, with the edge bevelled off hexagonally. The vats in nearly every case were encircled by consecutive raised rings, (Fig. 15) and it is possible that in the few cases where these were lacking they had been weathered off, as all were in low relief.

Across the plain nearly five miles from Boeleli were nineteen more stone vats of various sizes, the largest one (Fig. 16) standing about seven feet above the ground and measuring more than that in diameter. I dug under



Fig. 3. Stone vats in Besoa. The outer edges of the rim are rounded, the sides slightly bulging. Note size in comparison with horse and natives



Fig. 4. Elliptical vat at Napoe. Unlike the circular vats of Besoa this one is long, not deeply hollowed-out, and comparatively crude. The natives have referred to it as the "bath place" of a prince

the lower edge of this and made certain that it too was bevelled hexagonally below. On this vat, the only

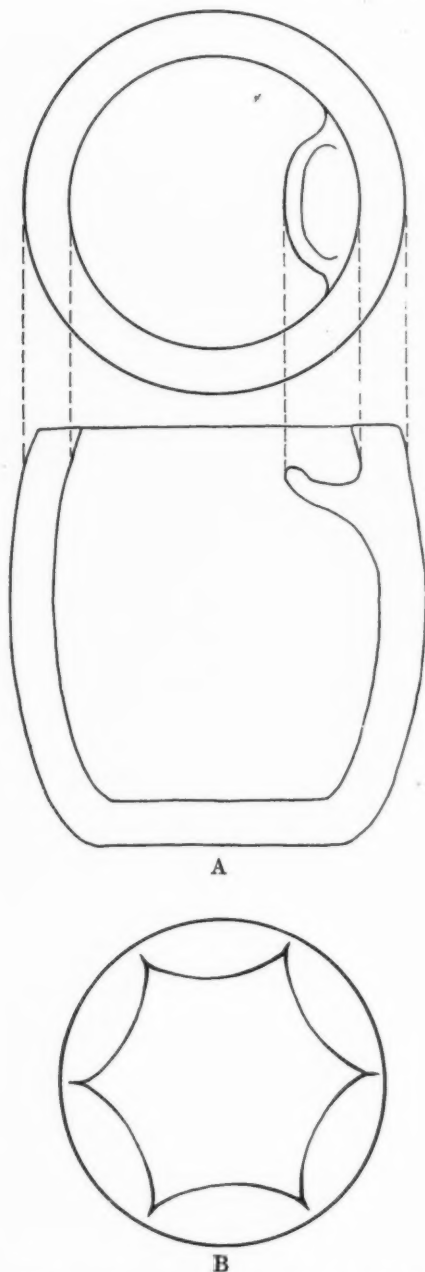


Fig. 5.—(A) Diagram of the stone vat pictured in Fig. 17, to show the concave shelf on the inside, a few inches below the rim. (B) Diagram of the bottom of a vat, to illustrate how the edge was bevelled hexagonally

one having any ornamentation other than the raised rings, was a series of faces resembling those of the statues and executed in relief around the upper third of the vat. Each of the faces was separated from its neighbor by a shallow vertical groove and the series bounded below by another groove encircling the whole vat, clearly seen in the photograph. All the vats that still remained upright were filled with mud and water in which there was a dense growth of sedge. I emptied some of these but found only mud and soft earth except in one in which there were in addition wood ashes and fragments of a clay pot. The simplest cover, made for one of the small vats, was smooth and flat below, evenly convex above but somewhat weathered, with a thin edge all around. Near-by was a squat, barrel-like vat much less in diameter at the top than through the middle, which if fitted with this convex cover would have appeared nearly spherical or at least domelike in side view. The three remaining covers were of about the same size, huge stone discs more than six feet in diameter and seven or eight inches in thickness, bevelled so that the diameter above was slightly more than that below. The simplest of these was decorated in the center with a nicely hewn knob more than a foot in diameter and six inches high. Another cover was carved with images of three large monkeys and one small monkey hewn in a row across the middle (Fig. 12). The most elaborate cover was also decorated with images of these black monkeys peculiar to Celebes. The figures were well modeled, arranged symmetrically around the periphery, and in the center was a raised circular boss, flattened on top (Figs. 14 and 15).



Fig. 6. Stone vat near the image "Tadoe Lakoe," Besoa (Fig. 13).—This vat was filled with mud and water in which sedge was growing. Note characteristic granite weathering, partially effacing the horizontal rings

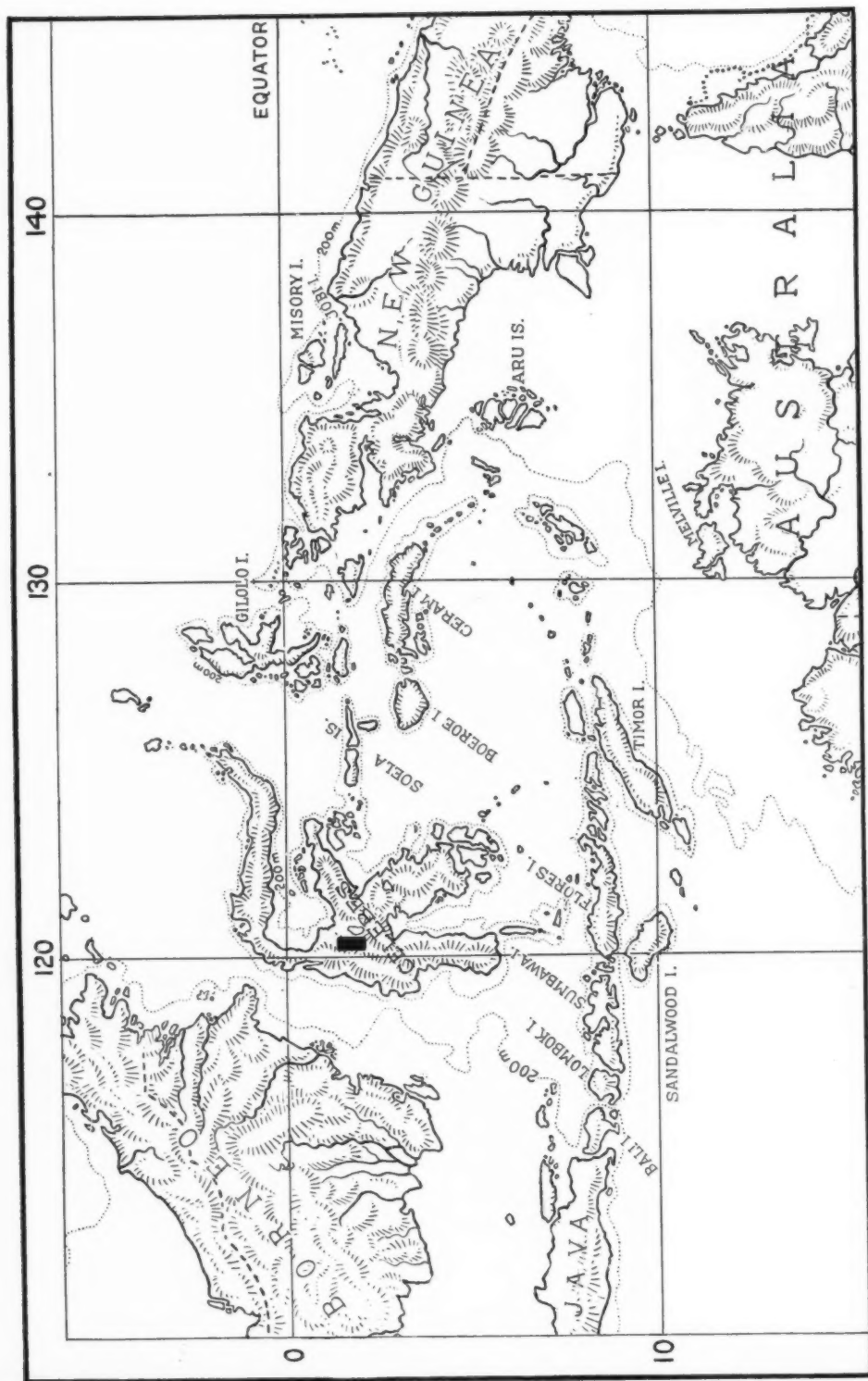
In the nine years since I left Celebes I have occasionally inquired among my friends and colleagues regarding these stone objects. All supposed them to be well known but none could tell by whom they were made, when, or for what purpose. Recently I have searched through much of the literature on the archæology of the Oriental-Indo-Malay-Pacific region in an effort to find out, if possible, to what culture

they belong. I am now able to compare them with somewhat similar stone objects in various other localities.

The literature reveals the fact that some of the stone objects shown here were briefly described in 1908 by Mr. J. Th. E. Kiliaan,<sup>1</sup> an official of the Netherlands East Indian Government.

<sup>1</sup>Kiliaan, 1908. "Oudheden Aangetroffen in het Landschap Besoa (Midden-Celebes)," *Tijdschrift voor Indische Taal-Land en Volkenkunde*, Vol. L, pp. 407-410.





SKETCH MAP OF CELEBES AND ADJACENT EAST INDIAN ISLANDS

(Indonesia, in part)

Fig. 7. The black rectangle on Central Celebes covers an area of approximately 1,000 square miles, including the mountainous districts of Badu, Beson, and Napos, where the stone of *Acacia horrida* described here is located.

Later the same year another brief notice was published by the Reverend Dr. Albert C. Kruyt,<sup>1</sup> who better understood the inhabitants of the country and on that account was able to learn more from them and to correct certain statements made by the original discoverer of the stones as well as to add new facts. Doctor Kruyt also reports three fallen images from Besoa in the vicinity of the vats with the covers described above, and in addition, a mortar at Sigi in the Paloe valley. In a more recent publication he mentions another image at Gintoe in the district of Bada. This image, however, is buried up to its neck in the earth.

The only general work, so far as I know, that treats of East Indian archaeology earlier than the Islamic, Buddhist and Hindoo cultures, is that of W. J. Perry, 1918, on *The Megalithic Culture of Indonesia*. In this book the attempt is made to show that the stone objects of Central Celebes are part of an early culture that was spread from Burma to Nias, Borneo, Celebes, Sumbawa, Flores, Sumba, Timor, Aru, "Seran" (=Ceram), and adjacent small islands as well as Formosa, by "stone-using immigrants" who imposed this culture upon the indigenous peoples of "Indonesia"; also that these stone-using immigrants, who were in search of gold and other wealth, introduced many other customs, among them terraced irrigation, metal-working and rice-growing. He states further: "Finally, it must be remembered that the existence of megalithic monuments, terraced irrigation, mining sites, the sun-cult, 'children of the sun,' and other elements of the culture introduced by

stone-using immigrants has been recorded in all inhabited regions of the earth." Notwithstanding this implication of relationship, the vats and images of Celebes contrast so strikingly in shape and other characters with stone objects in other parts of the Indo-Malayan region that I cannot believe that they belong to the same culture.

Mr. Perry remarks<sup>2</sup> that stone seats occur at Napoe and Besoa and Doctor Kruyt describes as stone seats what I have termed shelves in the inside of the vats. The one at Besoa is shown here both by photograph and diagram (Figs. 5A and 17) and though it may be said to resemble a seat it is, I believe, too small, and is placed where it could not be used as such. Thus if we consider these as shelves there are no known stone seats in Central Celebes to be compared with the stone seats of other places, such as those of Nias, figured by Modigliani,<sup>3</sup> which closely resemble large modern arm chairs.

Just beside the image at Boeleli are two or three small stones to which Kiliaan gave mention as the children of the woman who had, in the native legend, been turned to stone.<sup>4</sup> On this account apparently Perry refers<sup>5</sup> to this as a *cromlech*, but I am unable to see any resemblance to such a structure. These stones are seen in the photograph (Fig. 13a and b) to be simply pieces of rock, possibly used to brace the image, and they are beside it, not under it.

If we look at stone objects made by Buddhists in India, China, Japan, or the East Indies, we find a remarkable similarity among them. The same is true of objects made or introduced by other peoples whose influence and

<sup>1</sup>Kruyt, 1908. "Nadere gegevens betreffende de Oudheden Angetroffen in het Landschap Besoa (Midden-Celebes)." *Tijdschrift voor Indische Taal-Land en Veenkunde*, Vol. L, pp. 549-551.

<sup>2</sup>Perry, W. J., 1918, p. 36.

<sup>3</sup>*Un Viaggio A Nias*, pp. 311, 313.

<sup>4</sup>Kiliaan, 1908.

<sup>5</sup>Perry, W. J. 1918, p. 52.

migrations can be traced with certainty. It is then to be expected that if the stone culture of an earlier day, the remnants of which are to be seen in Central Celebes, was brought by stone-using immigrants who spread their images and structures so widely through Indonesia, all these images and structures would very closely resemble one another. Such, however, is not the case.

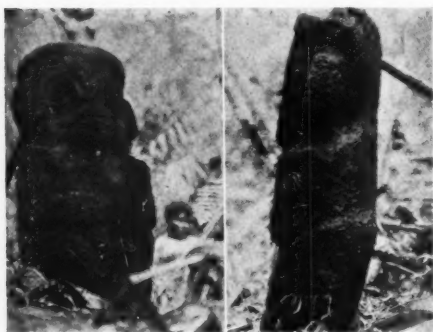


Fig. 8. Marquesan stone image. Resembling those of Celebes more closely than anything which is geographically nearer, yet differing in many features. After Linton

A comparison of these objects with all other stone objects of which I could find figures or descriptions has led me to the conclusion that those of Celebes are not closely related to anything of the kind thus far known from the East Indian region.

There has been found on the island of Nias, west of Sumatra, a small statue (about twenty inches high) with a round face and head as wide as the body, similar to the Celebes images in these particulars but differing in the possession of legs and a mouth, and also in the position of the hands and the shape of the eyes, ears, and other features.<sup>1</sup> Thus it is not very close to the images with which we are here concerned. No stone vats are recorded from Nias.

<sup>1</sup>Modigliani, *Un Viaggio A Nias*, p. 308, fig. 63.

Not finding any resemblance nearer, I turned toward the Pacific. In the Caroline Islands<sup>2</sup> prehistoric stone objects are found in the form of large discs three feet or more in diameter with a hole in the center, but no human images or vats are recorded. In the Marquesas many stone and wooden human images have been found<sup>3</sup> which resemble the Celebean statues in general shape, and in fact are closer than anything seen nearer Celebes. I therefore figure one of these Marquesan images (Fig. 8) so that the reader may make his own comparisons. They differ from the Celebean images in the following points: (1) no eyebrows are represented; (2) the nose is short and wide; (3) the mouth and lips are large; (4) the face is flat or convex, not concave; (5) arms are very distinct; (6) the hands rest on the chest, not on the abdomen; (7) the posterior limbs are always present. It is seen then that although the Marquesan images in general form are like those in Celebes, the differences are also striking.

Finally we come to the huge images of Easter Island. Due to the good descriptions and illustrations of these by Mrs. Routledge<sup>4</sup> a very satisfactory comparison can be made with the images of Celebes. The Easter Island images are several times larger than the Celebean and they differ from them in certain respects but in others they bear a marked degree of resemblance. It will be seen in a comparison of the Besoa figure "Tadoe Lakoe" (Fig. 13a and b) with the Easter Island image (Fig. 9) here reproduced, that they differ in fewer characters than do the other images available for comparison.

<sup>2</sup>Christian, F. W., 1899, *The Caroline Islands*, p. 236.

<sup>3</sup>Linton, Ralph, 1925, "Archæology of the Marquesas Islands," *Bishop Mus. Bull.* 23.

<sup>4</sup>Routledge, Mrs. Scoresby, 1919, *The Mystery of Easter Island*.

It seems very probable that ancient sculptors would model their figures after their own people, therefore the features represented in the examples of their art should bear a resemblance

guished type, brachycephalic, hypsicephalic and leptorrhine. This third type with short high heads and slender noses has been termed a Malayan type. Its characters are to be seen in the



Fig. 9. One of the great stone figures of Easter Island.—Note the arms and hands in low relief, with the hands on the abdomen as in the Celebean images. After Routledge

to their makers. Turning with this in mind, to the literature on the physical features of the peoples of Polynesia<sup>1</sup> I find three types are recognized: the first or Polynesian is dolichocephalic, hypsicephalic and leptorrhine; the second or Indonesian, brachycephalic, hypsicephalic, platyrrhine Negrito in type; the third and less easily distin-

images of both Celebes and Easter Island, although those of the latter have the large long nose, large chin and heavy brow of the Polynesian. All the points of difference between the Marquesan and Celebean images are here points of resemblance. Another interesting point is afforded by the hooklike markings on the breast of one of the Napoe statues of Celebes (Fig. 1) in comparison with designs for tat-

<sup>1</sup>Sullivan, Louis R., 1923, "Marquesan Somatology with Comparative Notes on Samoa and Tonga," *Mem. Bishop Mus.*, IX, No. 2, p. 232.

tooing formerly used by the natives of Easter Island (Fig. 10).

No vats or anything resembling them are recorded from the Marquesas, but of Easter Island the following state-



Fig. 10. Tattoo designs used by Easter Islanders within the memory of the oldest natives. After Routledge.

The hooks on the breast strikingly resemble those on the Celebean image shown in Fig. 1

ment is made: "There is a roughly constructed ahu [burial place] on the outside of Rano Raraku at the corner nearest to the sea, of which more will be said hereafter, and a quarried block of rock on the very top of the westerly peak was also said to be used for the exposure of the dead. Close to this

block there are some very curious circular pits cut in the rock; one examined was 5 feet 6 inches in depth and 3 feet 6 inches in diameter. It is possible they were used as vaults, but, if so, the shape is quite different from those of the ahu."<sup>1</sup> Thus we see that Easter Island also has its circular vatlike pits near the images.

While considering the points of resemblance between Celebes and Easter Island, it may be mentioned that in looking over a glossary<sup>2</sup> of some fifty words, several are the same as words used by the people of Central Celebes as Rano for lake, Manu for bird, Atua for God, Ika for fish, etc.; and there are others that look as if they might sound like Celebean words if due allowance were made for differences of spelling.

My conclusion is that the similarities in physical features must be largely discounted, due to the great mingling of peoples throughout the whole region. The positive evidence, such as the lack of legs, the placing of the hands, the hooks on the breast (compared with tattoo patterns), the association of circular vats and images, and similarities at the present time in the languages of the two places, may prove to be indicative of rather close cultural relationship. Much further archaeological exploration of the whole region, however, is necessary before the questions raised by the stone objects of Celebes can be fully answered.

<sup>1</sup>Routledge, 1919, *The Mystery of Easter Island*, p. 191.

<sup>2</sup>Routledge, p. 123.







## The Stone Images and Vats of Central Celebes



THE STONE MAN AT NAPOE

Fig. 11. An image stands among ferns in second-growth jungle not far from the village of Watoe Taoc (=Stone Man) in the Napoe district now inhabited by a happy peaceful Toradja people, who but a comparatively few years ago were warlike head-hunters. Is this image evidence of the artistic skill of their ancestors or of another race?



Fig. 12. Partly buried under earth and coarse grass was the granite cover for a huge vat and across this cover were carved three large monkeys and one small one



Fig. 13. Front and side views of the image at Boeleli Besoa, known to the inhabitants as "Tadoe Lakoe"



Fig. 14. A great vat in Besoa filled with mud and water on which sedge is growing. The cover is to be seen just as it was shoved off



Fig. 15. The same vat as shown above, from another angle affording a better view of the cover and the arrangement of monkey figures on it





Fig. 16. The largest of the Besoa vats, about seven feet high and nearly ten in diameter, is the only one ornamented with faces



Fig. 17. One of the most interesting vats was cracked, of medium size, and provided with a shelf inside; like the others it was hewn from a single block of granite





# Man and His Creations

SOME EARLY RESTORATIONS OF ANIMALS OF THE PAST

By FREDERIC A. LUCAS

Honorary Director, American Museum

WHEN Barnum's Museum was one of the institutions of New York, Barnum is credited with having said that "the public likes to be humbugged." Were Barnum on the staff of a modern museum he might say after reading some of the letters of inquiry that man prefers the improbable to the probable and is loath to accept a simple explanation of some fact, or object, if a more extraordinary one seems to fit the case.<sup>1</sup> And this seems to be particularly true when fossils, or things that look like fossils, are concerned.

Now mankind is gifted, or afflicted, with what in the *Elephant's Child* was called "satiabie curiosity" but which he terms thirst for knowledge. So when man began to find fossils he set about for a reason for their existence and sought for some explanation of what they were.

With fossil invertebrates the problem was simple: they were evidences of the flood, when the water covered the face of the earth; that the shell fish increased with astounding rapidity and distributed themselves amazingly in the space of a few months seems not to have troubled these theorists.

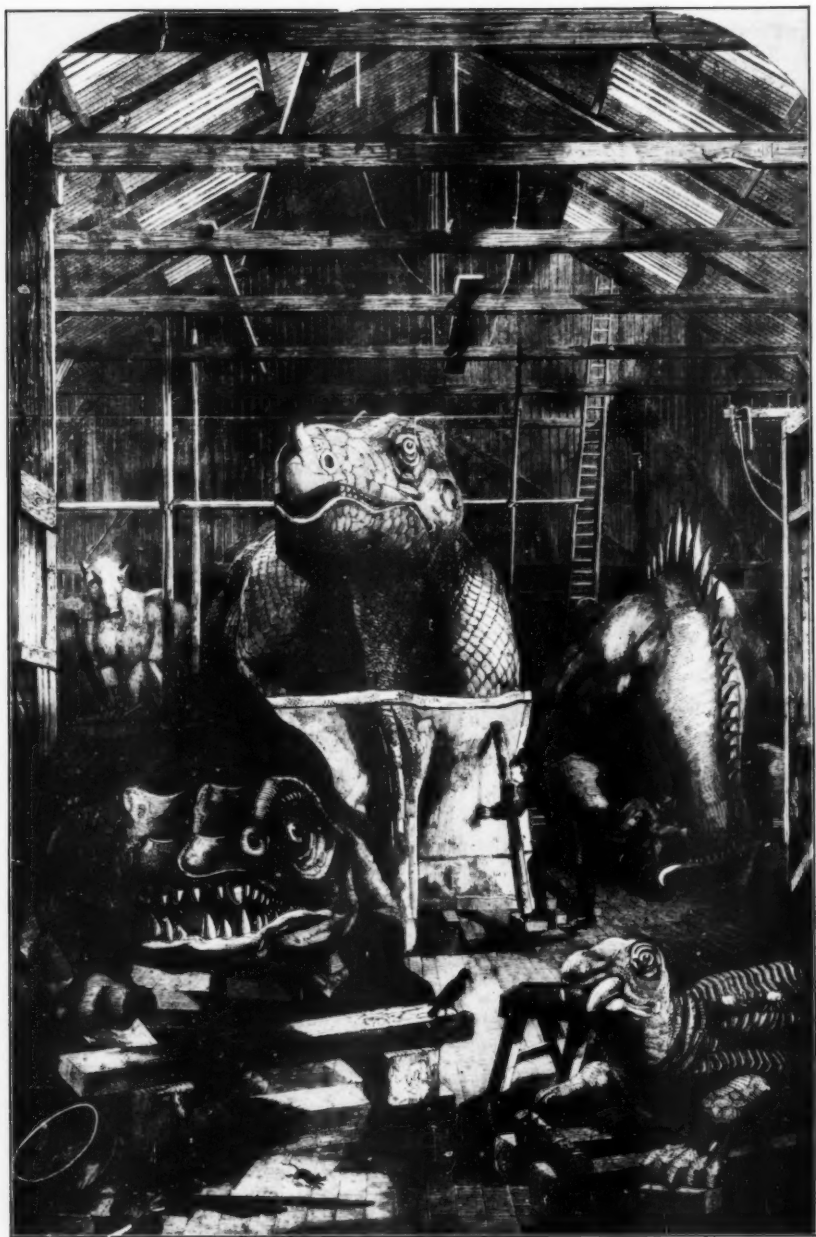
Vertebrates, however, allowed more play of the imagination and, after passing through the stages of considering them as "freaks of nature" and later having decided that they were

neither jettison from the Ark nor the remains of Hannibal's Elephants, men went to the other extreme of considering that they were animals quite unlike anything living. In many instances they were of course quite right, but having few facts to interfere with their theories, some of the earlier attempts at reconstruction could have been worshipped without violating any commandment, since they resembled nothing in the heavens above, the earth beneath, nor the waters under the earth. One of the most popular ideas concerning them was that they were the remains of giants, not so surprising when based on the leg bones of Mammoth or Mastodon which, to the uninitiated, have a decidedly human look. And mankind dislikes to give up the idea that there were "giants in those days."<sup>1</sup>

So we have Teutobochus, King of the Cimbri, 19 feet high and the Scotch "Littell John" with a height of 14 feet and other notables. And in America so late as the beginning of the eighteenth century we have the "giant" described at some length in the article on Jefferson, apparently the same specimen noted by the Rev. Cotton Mather and credited with a height of 40 feet. There were no restorations of these early giants probably because they were regarded as having the likeness of men and, so far as we know, the first restoration of an extinct vertebrate was made in 1749 by G. W. Leibnitz in a publication whose Latin

<sup>1</sup>Does not a recent writer of popular articles on primitive man credit the Cro-Magnons with attaining a height of ten feet!

A glowing, or glaring, instance of this occurred to the writer many years ago when he identified an object sent from Kentucky as the breastbone of a horse. The writer was not pleased with this identification, and wrote a most abusive letter in which, among other things, he remarked that it was evidently "an aquatic sea monster" that came up the Ohio and was killed by leeching fresh water.



WATERHOUSE HAWKINS' WORKSHOP, IN WHICH WERE MADE THE MODELS  
FOR THE RESTORATIONS AT THE CRYSTAL PALACE

From the *Illustrated London News* about 1852





The earliest known restoration of an extinct animal from a work published in Latin by G. W. Leibnitz in 1749. Rendered into English the title reads "Concerning the Primitive World, the Early Aspect of the Earth, and the Original Monuments of its most Ancient History"

title when translated reads:

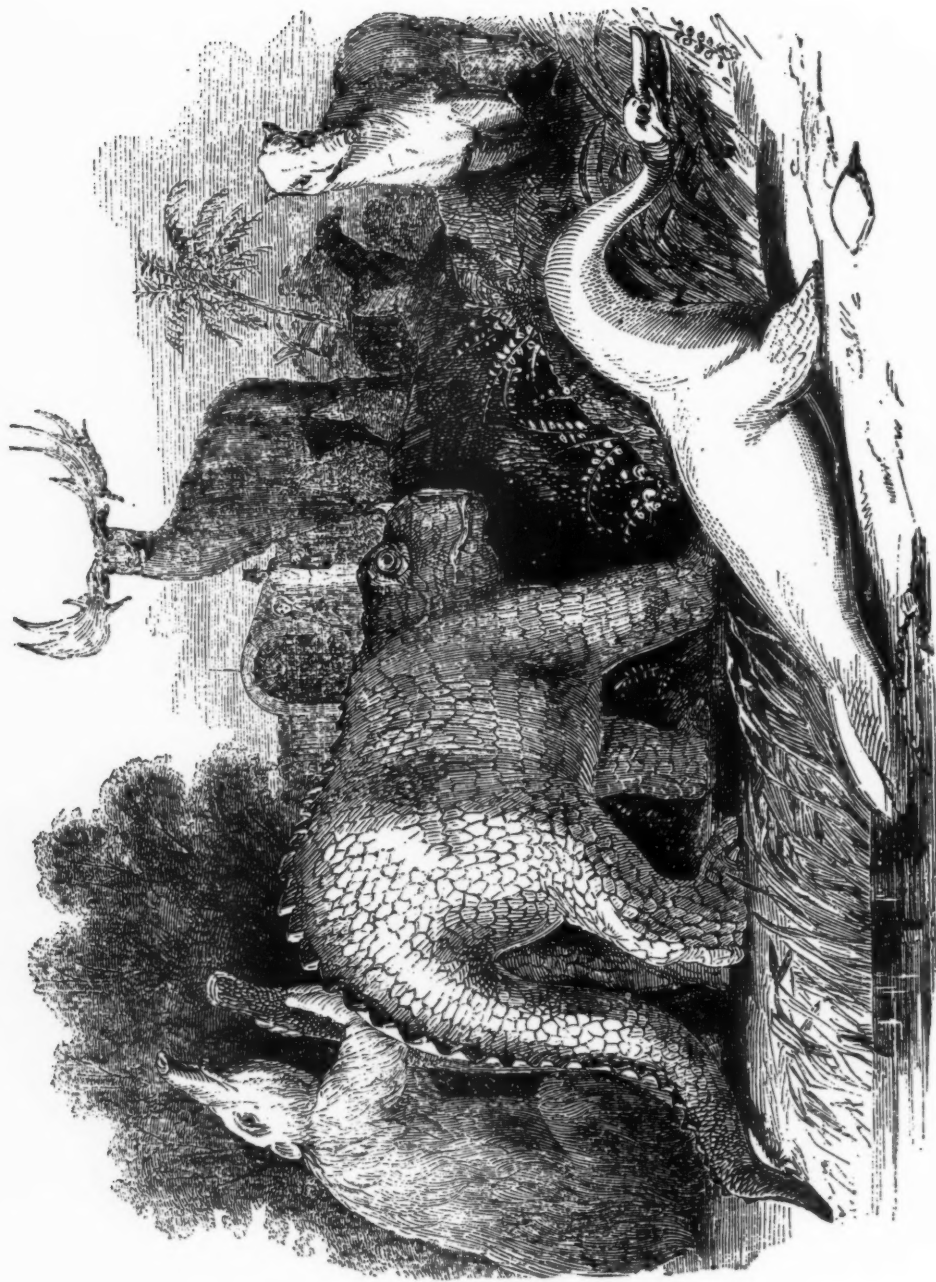
*Concerning the Primitive World, the Early Aspect of the Earth and the Original Monuments of its most Ancient History.*

This appears to have been based on the skeleton of some ruminant, as indicated by the jaws and the curious tail, which is apparently a series of dorsal vertebrae upside down: the long horn was probably thrown in to improve the looks of the restoration.

We may smile at the curious assem-

blage of bones, but it was scarcely more amusing than the skeleton of the whale shown for many years in the Niagara Falls Museum in which the vertebrae were jumbled together, and often turned hind side before. It is, perhaps, hardly fair to call the Rectangoremusa "restoration" since it was doubtless constructed to deceive, yet many who beheld it may have looked upon it as "the real thing."

Even as late as 1860 Waterhouse Hawkins constructed his restorations



GROUP OF EXTINCT MONSTERS

Restorations designed by B. Waterhouse Hawkins for the Crystal Palace, Sydenham, England.  
Reproduced from *The Leisure Hour*, April 20, 1854, London

at the Crystal Palace much on the same principle and, when Owen, master anatomist of his day, told Hawkins that he had put two toes too many on *Iguanodon* (a three-toed dinosaur), Hawkins replied that if they were corns he would gladly remove them but as they were toes they must remain, and there they are.

Hawkins came very near inflicting his restorations on New York in the then new Central Park and when Judge Hinton had the molds destroyed a storm of protest arose. Fortunately Judge Hinton destroyed (not builded) better than he knew.

Now Hawkins *did* have some facts to guide him, but some of the names applied to these extinct creatures seem to have stimulated his imagination; thus *Iguanodon* naturally implied iguana and so the first restoration of our duck-billed dinosaur—*Trachodon*, a relative of *Iguanodon*—depicted him with the skull of an iguana magnified many times.

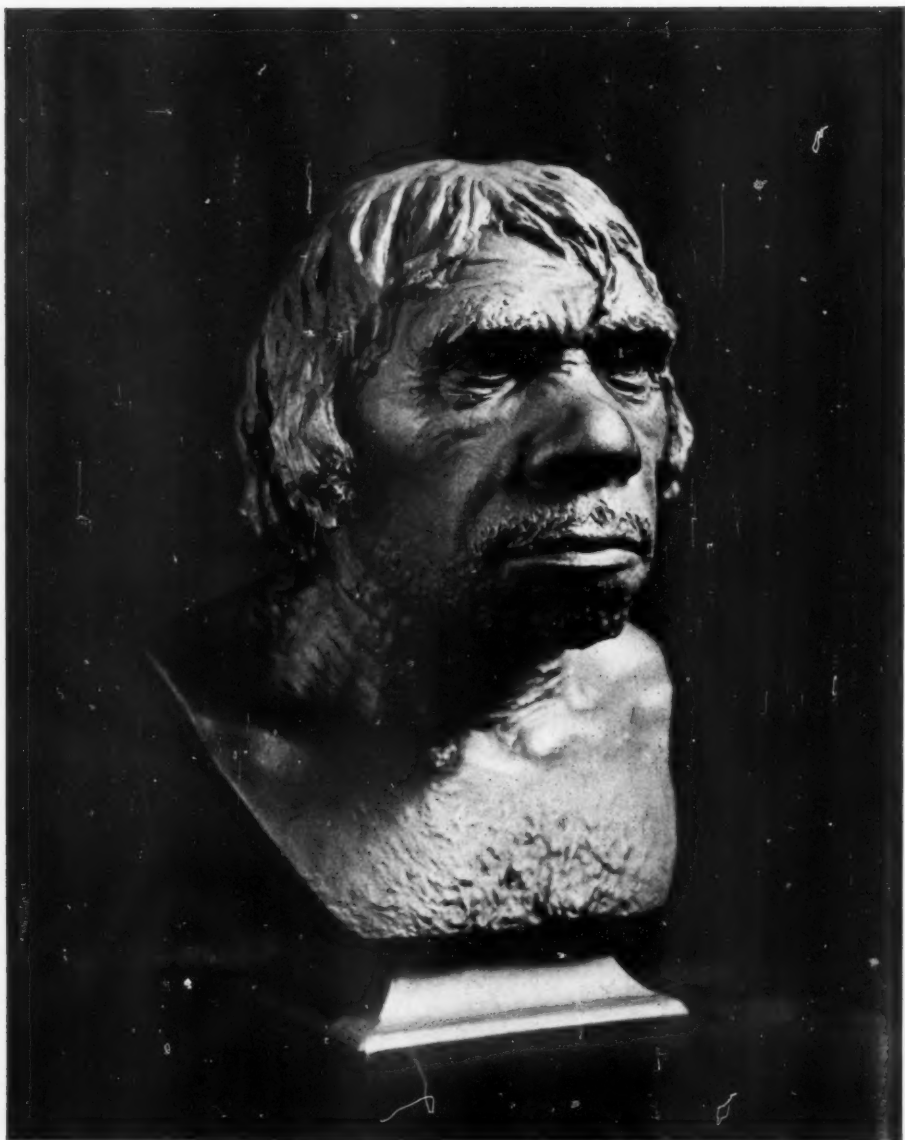
The long, slender ischia—part of the hip bones—were a puzzle—a puzzle that was solved by making marsupial bones of them. Similarly one of the names bestowed upon the big salamander-like creatures known as labyrinthodons was *Megalobatrachus*—giant frog—so Hawkins made him a giant frog, a frog the size of an ox, the dimension striven for by the frog in the fable. Here, too, Hawkins had some thing besides the name to stir the imagination, for the flattened, fossil skull of the animal does look very like the cranium of a huge bull frog. The crushed remains of another fossil salamander, about the size of the existing giant salamander of Japan, suggested to an observer with imagination a flattened human skull, and while its

relationships had been recognized by its describer, a writer with less knowledge and more imagination saw in it the remains of one of the victims of the flood and dubbed it *Homo diluvii testis*—man, the evidence of the flood. Assuredly our forefathers believed that natural processes moved rapidly in “the days when the earth was young” and considered that but a few years were required to convert mud into many feet of solid rock.

To realize just how credulous men were one has but to glance over the first descriptions of the *Treasures of the British Museum* and to read extracts from the minutes of the meetings of the Royal Society published in recent numbers of *Nature*.

To say that men *were* credulous is, however, altogether too flattering to the present generation which has an undying belief in petrified men and a real love for living frogs in Carboniferous rocks. And if we smile at these early restorations yet the words Cardiff Giant, Ponzi, and Mrs. Howe's Bank, though painful to some, may cause most of us to smile still more broadly.

These curious creations of days gone by were largely due to the fact that their creators had more imagination than information, few facts to interfere with their theories. As time has passed we have become better acquainted with these inhabitants of the ancient world and in many cases have complete skeletons, and in rare instances their very skin has been preserved. The relation of muscles to bones has been carefully studied, and save in the matter of color, little has been left to the imagination in the restorations shown in the American Museum of Natural History.



#### NEANDERTHAL MAN

The completed Neanderthal head modeled on the restored skull of La Chapelle-aux-Saints. This is the same as the hairless model, Figs. 5 and 7, with the addition of hair and eyebrows, and a slight suggestion of beard, not sufficient to obscure the chin form. A few wrinkles were indicated, and the iris and pupil incised so that their shadows might lend life to the eyes. Restoration by J. H. McGregor, photographed by A. F. Huettner

# Restoring Neanderthal Man

By J. H. MCGREGOR

Professor of Zoölogy, Columbia University: Research Associate in Human Anatomy, American Museum of Natural History

IN the Hall of the Age of Man, in the American Museum of Natural History, are several busts modeled on skulls of prehistoric races of man. Some are based on nearly complete skulls, others on crania which are more or less fragmentary. On seeing these heads, the visitor, if he be of an inquiring turn of mind, is likely to wonder how authentic such effigies can be. As the maker of the restorations in question, I have often been asked how much may be inferred regarding the features from the underlying skull. Sometimes the question takes virtually this form,—“Is it possible to model a portrait head on a skull without other data?” My answer is a decided negative, if by a “portrait” is meant a *personal likeness*, and if “without other data” is to be taken literally. In a collection of modern skulls the anthropologist can distinguish race, approximate age, and usually sex, without difficulty, but even if, for example, he knows a certain skull to be that of a middle-aged man of northern Europe, he cannot say how fat or how thin that man was, whether he was bald or whether he wore a beard, yet obviously these are matters of importance in portraiture. Even when these details are known, they afford no index to certain subtleties of facial expression which are essential in a personal portrait.

While therefore I do not consider it possible to construct an individual likeness solely on cranial data, the skull is a great aid in modeling a mask or bust of a *known* individual especially if photographs or other portraits are available. Portrait busts have thus

been modeled on the skulls of several famous men, for example Schiller and Bach. But newspaper accounts of the identification of murdered men from the features modeled on skulls discovered long after death, when there was no other clew, are not to be accepted at face value, unless the skull in question possesses some outstanding peculiarity.

Of course skulls exhibit racial characters. The physical anthropologist can distinguish the crania of Negroes, Mongols, and Europeans almost as readily as the layman can identify the living types, and if a sculptor-anatomist were to model the soft tissues on, say, a dozen typical skulls of each of these three races, the layman could doubtless assign most of them to their proper racial groups even in the absence of hair and color differences. Such heads would not be individual portraits, but type models or *racial portraits*. Such racial portraits are all we can hope to attain in reconstructing the soft tissues on skulls of extinct races, where we have no data except the bones, and no information as to hair or complexion, but after all, a racial model has more scientific value than an individual likeness. During the past few years I have attempted such restorations of soft parts on five skulls: *Pithecanthropus erectus*, the Piltdown man or *Eoanthropus*, the male Neanderthal skull of La Chapelle-aux-Saints, the female of the same species from Gibraltar, and the “old man of Cro-Magnon.” Of these the data for the first two are relatively incomplete, while the Cro-Magnon is so like certain modern European types



that it is not particularly interesting; but the Neanderthal, representing a type distinctly different from our own species, and known from a considerable number of examples, is one which has special interest as a problem in restora-

tion. In the present article I shall, therefore, try to indicate the possibilities and the limitations of restoration as exemplified in *Homo neanderthalensis*, and specifically the man of La Chapelle-aux-Saints. This skull,—on the whole the finest of the race or species thus far discovered,—was found in 1908, in the department of Corrèze in France. The remains, which comprise a considerable part of the skeleton, are widely known through a splendid monograph by Professor Marcellin Boule of Paris.

The skull, which was broken into a number of fragments, was admirably reconstructed by Professor Boule (Fig. 1). It is that of a man rather past middle life, most of whose teeth had been lost prematurely through a suppurative disease of the gums, so that the jaw is more senile in form than would otherwise have been the case. The lower jaw had become slightly warped (a common post mortem occurrence with fossil jaws), so

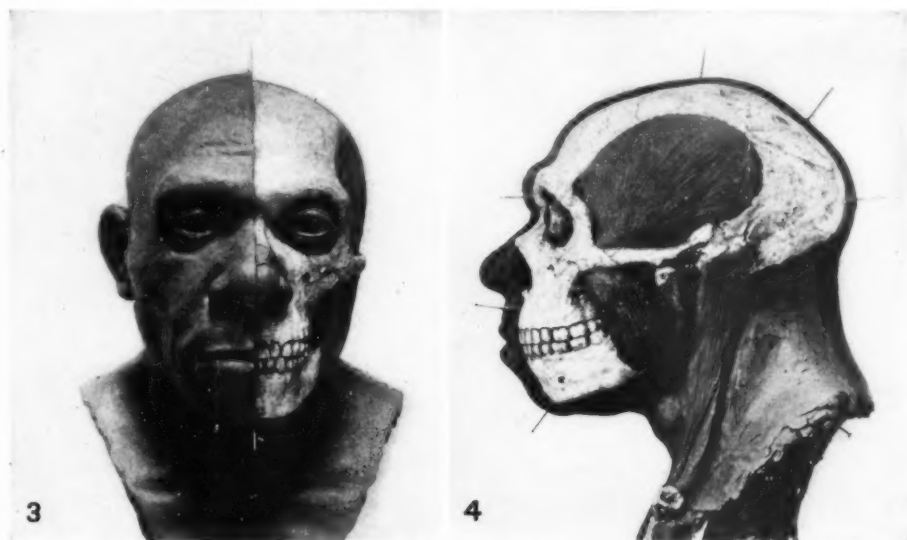
that it was too wide to articulate properly with the cranium. The skull was so nearly complete that restoration of the missing parts was not difficult. These portions were restored by me on a cast of the skull, and the teeth modeled from numerous casts and photographs of other Neanderthal remains, chiefly those from the rich finds of this race at Krapina, in Jugoslavia. The post mortem distortion of the lower jaw was remedied by a laborious process which involved making, first, a flexible cast in hard plaste-line, and from this, after correction, a second cast in plaster. The lower teeth were then modeled to conform to the upper, using again the photographs and casts of other Neanderthal teeth and skulls. The teeth, as restored, are those of a young adult, and not such as would be found in the skull of an elderly man. This placing of comparatively unworn teeth in old jaws may be open to criticism in that it produces an unnatural condition. Had all the teeth been retained the jaw would not have presented quite the senile form which it actually shows. This inconsistency was duly considered in making the restoration, and was deemed justifiable in that it enhanced



Fig. 1.—The Neanderthal skull of La Chapelle-aux-Saints. From Boule  
Fig. 2.—A plaster cast of the same skull with the teeth, nasal bones, and some other missing parts restored from studies of other Neanderthal remains. This photograph was made at too short focus, hence the proportions are not quite accurately represented

the value of the restored skull for the demonstration of the typical Neanderthal dental characters. The restoration of the missing nasal bones was a comparatively easy matter as the adjacent structures were mostly

this skull as restored. First the skull was fixed firmly on the so-called Frankfort horizontal or "eye-ear plane," so that a plane passing through the lower margin of the orbits and the upper margin of the auditory meatus



Copyright by J. H. McGregor

Figs. 3 and 4.—These figures show the skull posed on the Frankfort horizontal plane, with the large muscles modeled in plasteline, and the plaster eyeballs in place. In Fig. 3 the tarsal plates of the eyelids and the removable nasal cartilages are shown on the left side

present, and casts of two other Neanderthal skulls,—from Gibraltar and Krapina,—with complete nasal regions, were available for comparison. Some other less important gaps were also filled in. The skull, thus restored, represents a nearly perfect Neanderthal skull closely approximating the original condition except for the rejuvenation of the dentition explained above. (Fig. 2.)

The flesh restoration here described and figured was made in 1919. An earlier one was modeled in 1915, not on a cast of the original skull, but on a copy modeled from it by another person. The present restoration—based on an excellent cast—is far more accurate.

The head was modeled directly upon

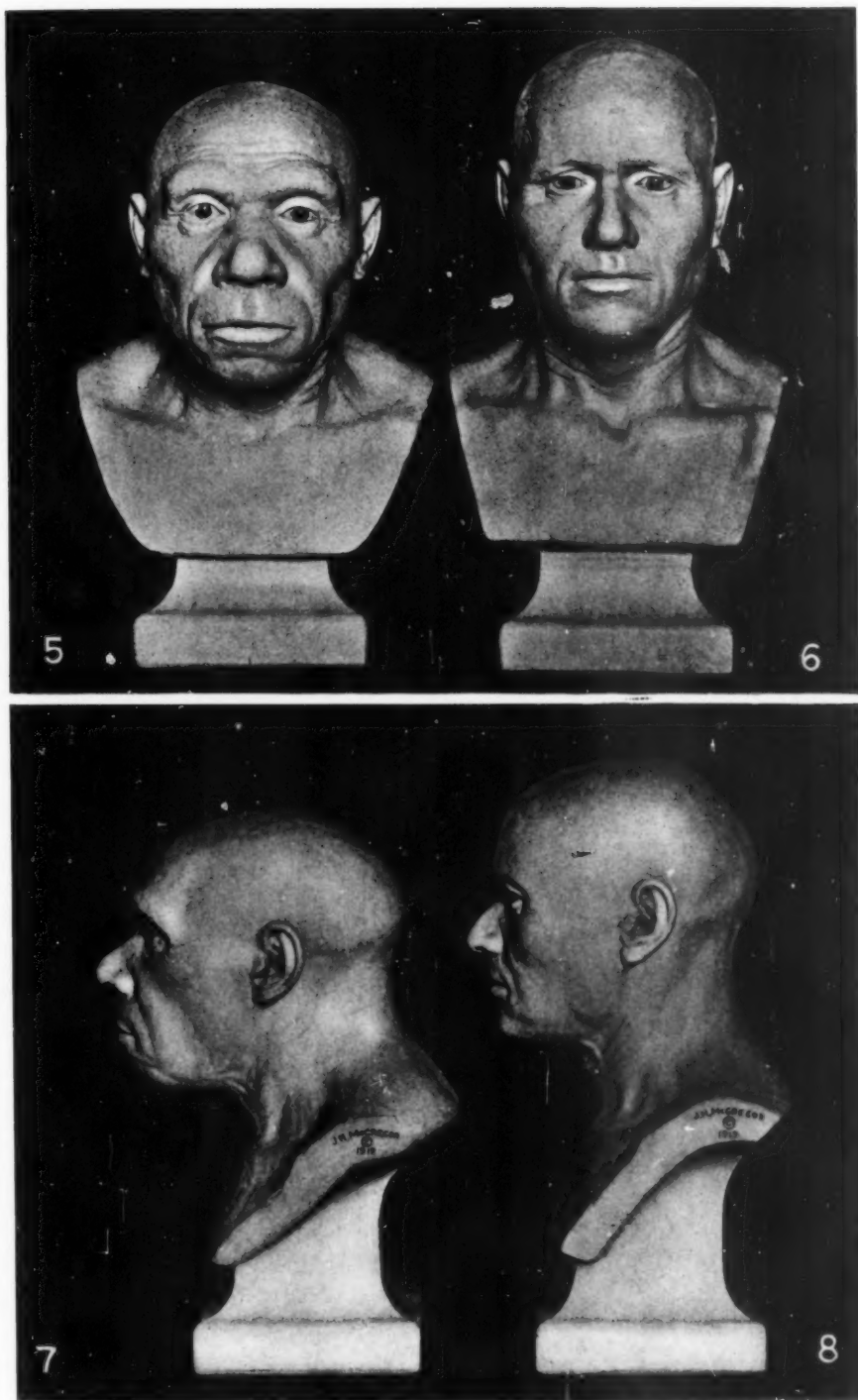
would be horizontal. This poses the head in a natural position, and, as all the other heads which I have restored were built upon skulls similarly oriented, comparison of slope of forehead, chin, etc. in the various models, is greatly facilitated. Special attention was devoted to the position and dimensions of the neck. From Professor Boule's published photographs and diagraph drawing of the cervical and anterior thoracic vertebræ, these bones were outlined in natural size, and a mesial section of the neck was constructed, drawing in, not only the vertebræ, but the upper end of the sternum in proper relation, the neck ligaments, oesophagus, hyoid bone, larynx, trachea, and other organs. This mesial section, drawn on card-

board, was adjusted to the skull to serve as a guide in modeling the neck. As may be observed from the photographs the neck, as reconstructed, is rather thick, but is far from being the bull neck which certain European restorers have conferred upon Neanderthal man.

Naturally the nose, eyes, and ears are features requiring careful attention. As to the nose it is clear from the nasal aperture of the skull that this feature must have been of great width. It is also certain that it was not flat or depressed, but prominent. Most restorations of Neanderthal man have been at fault in representing the nose as flat like that of certain negroid types. As published researches indicate a surprisingly slight correlation between the width of the nasal aperture and the external nose, the exact width of this organ is uncertain. Though very wide as modeled in the restoration it is not more so than in some Negroes. In order to attain as great accuracy as possible in this feature, the nasal cartilages were modeled in "moldolith," a commercial plastic material which becomes hard when dry. These were further constructed so that the two halves could be removed and replaced separately. (Figs. 3 and 4.) Modeling the eyes required great care. It is known that the centers of the pupils, when the eyes are at rest, are slightly nearer the outer than the inner orbital border, and slightly nearer the upper than the lower border. The size of the adult human eyeball varies but little as compared with variation of the size of the orbits, hence, although Neanderthal orbits are notably capacious, there is no reason to believe that the eyeballs were appreciably larger than in *Homo sapiens*. Eyeballs of the proper size were modeled, cast in

plaster, and inserted in the orbits with due regard to their relations to the orbital rim. This is not so simple as might be supposed. There is a normal variation of some 12 millimeters in the prominence of the eyeball in its socket, but in the usual position, which was adopted in this restoration, the front of the cornea is about in the plane intersecting the upper and lower borders of the orbit. The lacrymal sac and tarsal plates of the eyelids were modeled to serve as guides in constructing the soft tissues. (Fig. 3.) It may be remarked that the interpupillary distance is wide, 72 millimeters. Plaster casts of the nasal cartilages in place, and of the orbital region were made as records and for use in checking later measurements. In modeling the ear the point of greatest importance was to observe the normal relation to the bony meatus, or ear opening, in the skull. As there is nothing to suggest that the external ear was remarkable in any way, it was conservatively modeled as to size and form. There is no reason to suppose that the "Darwin's point" of the ear was more frequent or better developed in Neanderthal man than in his modern kin.

Figures 3 and 4 show how the large muscles,—temporal, masseter, and sterno-cleido-mastoid, were modeled, and how heavy bank pins were inserted at critical points to serve as guide-posts. Various investigations have been published, especially in Germany, on the thickness of the soft tissues on various regions of the head and face in cadavers of different races. These studies were invaluable in the present restoration. The thicknesses which I decided to use may be said to approximate the average for well-nourished but not fat individuals.



*Copyright by J. H. McGregor*

#### NEANDERTHAL AND CRO-MAGNON: A COMPARISON

Figs. 5 and 7 represent front and profile views of the hairless phase of the head modeled on the Chapelle-aux-Saints (Neanderthal) skull, and Figs. 6 and 8 show a head similarly constructed on a male skull of the Cro-Magnon race for comparison. The contrast facilitates recognition of the characteristic Neanderthal features such as form and relative size of cranium and face, the heavy brow ridge, alope of forehead and chin, wide but prominent nose and retreating cheeks



*Copyright by J. H. McGregor*

# NEANDERTHAL HEAD SHOWING RELATION OF FLESH TO SKULL



*Copyright by J. H. McGregor*

Figs. 9 and 10.—The Neanderthal "phantom," here shown in front and profile views exists only in the form of double-exposure photographs. The skull (Fig. 11A and the hairless head model (Figs. 5 and 7) were separately photographed and the two images of each were superimposed on the same plates to demonstrate the conformity of the restored soft tissue to the underlying skull. The double-exposure photographs are both elements of stereoscopic pairs, which, when viewed with a stereoscope give the impression of solid but transparent flesh enveloping the bones.



It seemed advisable to avoid disguising the skull form by excessive flesh. The local thicknesses adopted were indicated in millimeters on photographs of the skull, and kept as records, and a great number of pins were driven into the plaster skull at corresponding points and cut off at proper heights, and soundings of the depth of the plasteline were made constantly throughout the course of the work. Finally the head without the hair was cast. This model clearly shows the racial head form, shape of nose, chin, etc. (Contrast these features in the hairless heads of Neanderthal and Cro-Magnon men, Fig. 5-8.) It is really more valuable scientifically than the finished bust, in which the head form is disguised by hair, and of course we do not know the nature of the Neanderthal hair. It will be noted that the lips are not thick and everted as in the Negro, as the vertically placed incisor teeth with end-to-end bite render such lips unlikely, and moreover the negroid condition is almost certainly not a primitive character, but a racial specialization. After a mold had been made of this hairless phase, the plasteline was removed from the left half of the skull, leaving the "flesh" on the right side, and a cast of this "half-and-half" model was made. The double-exposure photographs or "phantoms" shown in Figs. 9 and 10 demonstrate the general conformity of the restored soft tissues to the underlying skull.

As a concession to popular taste, the hair was modeled on a plaster cast of the bald phase, and a slight suggestion of beard added, though not sufficient to disguise the form of the retreating chin, an important racial feature. Finally, this finished bust

was cast in plaster, as a racial model of an adult male *Homo neanderthalensis*. (See page 288.)

The stages of this restoration can be seen in the Museum: first, the cast of the skull before restoration; second, the same with the missing parts restored; third the "half-and-half" skull and hairless head; and, finally, the complete bust. In neighboring cases



Fig. 11—The skulls of Neanderthal (Chapelle-aux-Saints), A, and Cro-Magnon, B, after removal of the plasteline. "A" and the hairless head (Figs. 5 and 7) were used in making the double exposures shown in Figs. 9 and 10

may be seen casts of the remarkably similar skulls of this same race from Spy, Neanderthal, La Quina, and Gibraltar, and fragments of others, all of which were studied constantly in connection with this work.

In every phase and feature of this restoration I have tried to be conservative, to follow only the guidance of anatomical fact, minimizing my personal equation in the work as far as possible, and avoiding any inclination to make the result either bestial or noble. But the Neanderthal species was human, not brute, and though the semblance of the former flesh which clothes this ancient skull, is perforce low-browed and heavy-featured—it is the likeness of a man.

# Casts Obtained from the Brain Cases of Fossil Men

By G. ELLIOT SMITH

Professor of Anatomy, University of London

THE interpretation of the brains of extinct members of the human family on the basis of the evidence obtained by the casts of their skulls is a comparatively new field of research. In the first place, the material for such studies has only recently come into our possession, and, in the second place, the problem of interpreting the significance of such data as casts of brain cases afford, has only been made possible of solution by the development of our knowledge of the brain within the last fifteen years. In 1865 anatomists were still disputing as to the nature of the differences between the brains of men and apes, and controverting false assumptions that had been made with reference to certain characters claimed to have been distinctive either of the human or simian brain. Hence when Huxley wrote *Man's Place in Nature* he was not in a position to discuss, except in the most general way, the differences between the human and the simian brain, or to appreciate the features of the cast of the only brain case of fossil man then available,—that is the Neanderthal skull. In 1898 Dr. Eugene Dubois presented to the International Congress of Zoologists at Cambridge a report on the cast of the brain case of *Pithecanthropus*, which perhaps can be regarded as the true beginning of the history of this type of investigation. In that memoir Doctor Dubois concentrated attention upon the left inferior frontal region of the cerebral hemisphere in the attempt to discover whether the brain revealed any features

to throw light upon the question of speech. At that time it was commonly supposed by physicians that the ability to speak was entirely dependent upon the integrity of the left inferior frontal convolution, the so-called Broca's area; but it is now realized that the acquisition of speech was an extremely complicated process dependent upon the special development of a large series of widely separated cortical areas involving regions concerned with hearing, sight, and touch, and the combination of the three, as well as the more strictly motor or executive portions of the hemisphere. When the important discovery of a representative of the Neanderthal species was made at La Chapelle-aux-Saints in 1908, Professor Boule, in coöperation with Professor Anthony, began the investigation of the cast of its cranial cavity, and published an important monograph (in *L'Anthropologie*, Tome XXII, No. 2, 1911, page 50), which they further elaborated during the next couple of years. The announcement in 1912 of the discovery of the Piltdown skull aroused considerable controversy as to the nature of this hitherto unknown type of man, and especially as to the question of the possible co-relation between the skull and the jaw found with it. This discussion was responsible for focusing particular attention upon the brain as one of the important factors in determining whether or not the skull was of so primitive a character as to be associated with a jaw so suggestive of simian affinities. The widest discrepancies as to the shape and size of

this endocranial cast have been put forward during the last thirteen years, but there can now be no doubt whatever that the capacity of the brain case is very definitely below the average of modern man, and in addition that the cast of its interior reveals a form of brain which is more primitive in type than that of any known human brain, except only that of *Pithecanthropus*.

In approaching the study of the cast of the cranial cavity and attempting from it to interpret the nature of the brain that originally occupied a particular skull, our aims today are of a different nature than those of our predecessors. It is not so much the attempt to identify certain definite fissures and convolutions of the brain, as to determine the relative state of development of different functional areas of the brain. During the last twenty-five years it has been demonstrated that the search which began a century ago for certain features of the brain distinctive either of man or ape was a futile procedure because there are no such distinctive characters. No structure found in the brain of an ape is lacking in the human brain and, on the other hand, the human brain reveals no formation of any sort that is not present in the brain of the gorilla or the chimpanzee. So far as we can judge at the present time, the only distinctive feature of the human brain is a quantitative one, namely a marked increase in the extent of three areas in the cerebral cortex, the parietal, the pre-frontal, and the inferior temporal which are relatively small in the brain of the anthropoid apes and very much more insignificant in the brain of all other mammals. Hence the chief object is to base our conclusions not so much upon the absolute size of any

particular brain, as upon the relative size of those particular regions which are of chief significance in phylogenetics.

In a recent number of this Journal Dr. James H. McGregor has given an admirable account of the skull and brain of *Pithecanthropus*, and compared it with the casts of the brain cases of the gibbon, the gorilla, the Rhodesian skull, the Gibraltar skull, and others. In his excellent restoration of the complete form of the cast of *Pithecanthropus*, which I think is as accurate as the facts at present available warrant, he obtained a capacity of 940 cubic centimeters, which, as he pointed out, bridges the gap between the 580 for his gorilla and the 1,280 and 1,300 of other primitive men. The outstanding distinctive feature of the cast of this most primitive human brain case is the extreme flatness, which is due to the imperfect development of the parietal and frontal regions. The disproportionate and precocious overgrowth of the posterior part of the temporal area must be regarded as the tangible evidence of the sudden increase of the importance of the acoustic symbolism, which can have no meaning other than the inference that some sort of speech had been acquired by this most primitive and earliest known member of the human family. The widening of the brain in the posterior temporal area gives the primitive brain its most distinctive feature. The other point of interest in this cast is the fact that the marked asymmetry of the brain, which is peculiar to the human family, is already clearly defined; but as I have pointed out elsewhere ("Right and Left-handedness in Primitive Men," *British Medical Journal*, December 12, 1925) the asymmetry is of the kind which in modern man, and

presumably also in primitive man, is associated with left-handedness. Although the three significant areas of the brain, the parietal, the frontal and the temporal, are much larger than they are in any ape, they are, on the other hand, very definitely smaller than those of any other known human brain.

mentioned in *Pithecanthropus*, but with a greater fulness of the three significant areas.

The cast of *Pithecanthropus* in its general form is an anticipation of the peculiar shape seen in a more fully developed condition in the cast of the Rhodesian skull and those of the

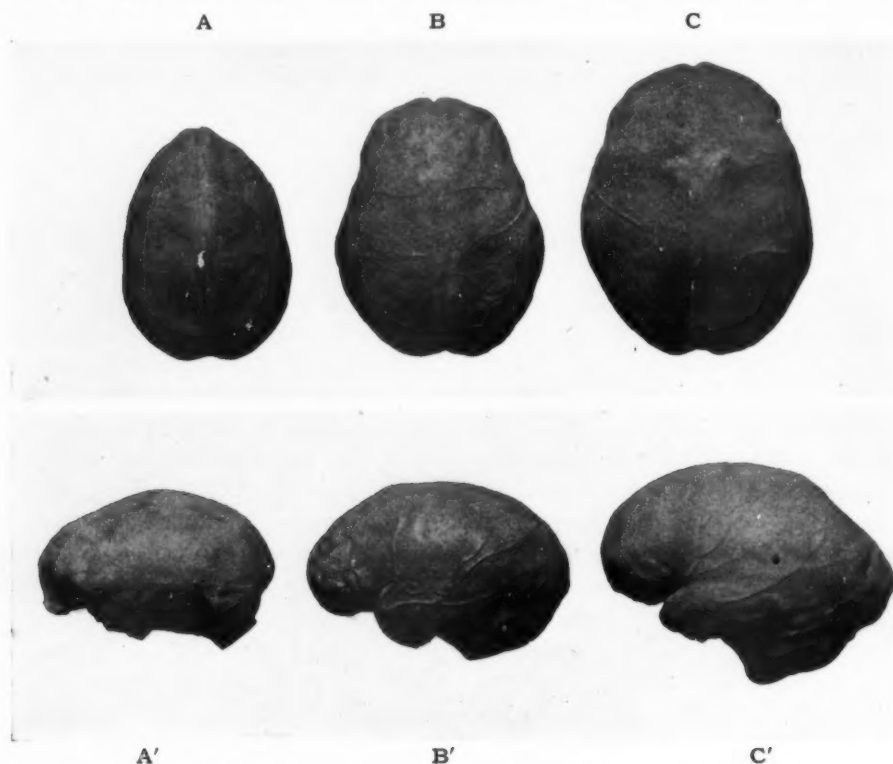


Fig. 1.—A and A', endocranial casts of male gorilla; B and B' *Pithecanthropus*, as restored by Professor J. H. McGregor; and C and C', Rhodesian man, top and side views. The three casts were photographed together to show the relative sizes. From J. H. McGregor

The cast that I have recently obtained from the restoration of the Piltdown skull, in the completion of which I received valuable assistance from the late Professor John I. Hunter and Dr. John Beattie, reveals a cast which is only about 1,170 cubic centimeters in capacity. The distinctive features of this cast are in the first place, the localized hypertrophy of the posterior temporal area, such as I have already

Neanderthal series. The Piltdown cast, on the other hand, although it reveals the flatness found in all human brains, excepting only the majority of members of the species *sapiens*, displays a form, especially in its posterior part, suggestive of the condition found in *Homo sapiens*. Both in *Pithecanthropus* and in *Eoanthropus* the deep broad notch found at the posterior extremity of the orbital

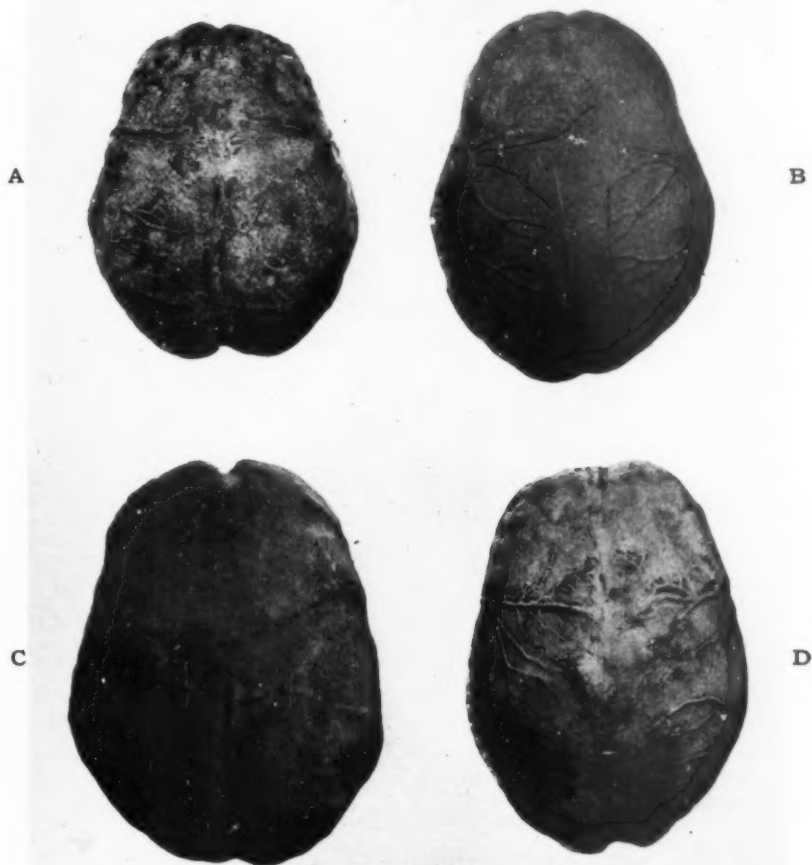


Fig. 2.—A, top view of endocranial cast of *Pithecanthropus*; B, *Eoanthropus* (Pitldown) restored; C, Neanderthal (La Chapelle-aux-Saints); and D, *Homo sapiens* (white man), photographed together to show relative size and form

margin suggests that the Sylvian fissure was widely open at its anterior end, as it is in the chimpanzee and the gorilla.

When we pass to the Rhodesian cast (Fig. 1, C, C') which is a little bigger than that obtained from the Pitldown skull, we find a brain that is considerably altered in form, in the direction which is familiar to us from the series of Neanderthal casts. The

uneven expansion of the brain in this process of development is more clearly displayed in this cast than in any other human specimen, and for this reason the Rhodesian cast is particularly instructive. The prominence on the posterior part of the temporal area is still apparent, although this region as a whole is still significantly small, a fact that is most obtrusively displayed in the lateral view. The pre-frontal area,





Fig. 3.—A, left side view of endocranial cast of *Pithecanthropus*; B, *Eoanthropus* (Piltown); C, Neanderthal (La Chapelle-aux-Saints); and D, *Homo sapiens* (white man), photographed together to show relative size and form. *Pithecanthropus* and *Eoanthropus* as restored by Professor J. H. McGregor

also, although significantly larger than that of the Piltown cast, and of course much larger still than in *Pithecanthropus*, is still obviously ill-developed in proportion to the general size of the brain. It has an appearance as though in a plastic state it had been taken in the hand and squeezed into a smaller compass. The openness of the Sylvian fissure, to which I have already referred in the case of *Pithecanthropus* and *Eoanthropus*, is still manifest in the Rhodesian cast, but in a less obtrusive form. There is a much greater approach to the closure of this fissure than there was in these more primitive types. In the parietal area there is an obvious expansion in comparison with

that of the Piltown cast, an expansion which affects mainly the inferior part of the parietal area, yet in no cranial cast is the defective development of the upper and posterior part of the parietal territory more distinctly demonstrated than in that of the Rhodesian specimen. One of the interesting features of the Rhodesian cast (to which I have already called attention in the lecture reported in the *British Medical Journal*) is the fact that the lunette sulci are approximately symmetrical on the two hemispheres; a condition that is found only very rarely in modern human brains and then specially in the Negro race.

When we come to the Neanderthal

series of casts, one finds a state of affairs that can be described as a brain of Rhodesian type, in which the great deficiencies found in that cast have been partially filled up. The brain in all members of this species is still exceptionally flat, with the occipital end pulled out in a very distinctive way. The pre-frontal area is still small, both relatively and actually, but is not so obtrusively diminutive as it is in the Rhodesian and the more primitive human casts. Nor does one find that irregularity of the contour of the parietal area which is so striking a feature of the Rhodesian cast. At the same time the parietal area in some of them, especially the La Quina and Gibraltar specimens is not nearly so full as it is in *Homo sapiens*, even in quite primitive representatives of that species like the aboriginal Australian. Hence in some of the Neanderthal casts, especially that of the La Quina specimen, the localized swelling of the posterior part of the temporal region, already noticed in the three more primitive members of the family, is still quite a recognizable feature. In the posterior extremity of the hemisphere one can detect the same sort of asymmetry found in *Homo sapiens*, although perhaps in a less obtrusive form. The great size obtained in certain of the Neanderthal series seems to be due to an increase in the extent of the primary sensory areas and of the parietal territory. There is no significant increase in the sizes of the pre-frontal and inferior temporal areas.

When we come to *Homo sapiens* the most significant change is the alteration in the contour of the brain; an increase in height and a diminution in

breadth of the brain. Both diameters, however, share in the secondary expansion that occurs later on in the higher types of brain so as to produce the high-domed and well-filled brain, which is so distinctive of modern man. Perhaps the most distinctive feature of the brain of *Homo sapiens* is the significant increase in the size of the pre-frontal territory, which becomes considerably bigger than it is in any other species of the human family. This leads to the filling out of the fore-head and confers upon modern man a distinctive type of brow which distinguishes him from all other members of the family. In spite of the enormous range of variations in the size and form of the brain of *Homo sapiens*, it never loses this distinctive feature. Although the brains of individual members of the species may be smaller than that of any of the known extinct types, not excluding even *Pithecanthropus*, the brain always differs in form from these types, and the reduction in size may affect other areas than those of the three significant regions that I have mentioned. Hence a very small brain in modern man presents a profound contrast in shape and relative size of areas to the brain of corresponding size in extinct members of the human family.

With the increase of our knowledge of the structure and functions of the cerebral cortex, it is now becoming possible to correlate in some measure the facts of cerebral anatomy in early forms of the human family with the developing powers of manual dexterity and ability to learn from experimentation, upon which man's growing understanding of the world in which he lives ultimately depends.

# The Crown Patterns of Fossil and Recent Human Molar Teeth and Their Meaning

By WILLIAM K. GREGORY<sup>1</sup> AND MILO HELLMAN<sup>2</sup>

THE crown of a *second lower molar* ( $m_2$  Fig. 1A) of a white person is very apt to comprise four main elevations or cusps, grouped in two transverse pairs. Two of these cusps, which we will designate by the odd numbers 1, 3, are on the outer or cheek side, and the other two (2, 4) on the inner or tongue side. The outer cusps are more or less flattened, conical, the inner ones when unworn bear low cross crests. These four cusps are separated at their bases by two prominent grooves that cross each other almost at right angles near the middle of the crown: the longitudinal groove starts in front between cusps 1 and 2 and ends behind between cusps 3 and 4; the transverse groove begins well down on the outer side between cusps 1 and 3 and ends on the inner border between cusps 2 and 4. If these grooves were perfectly straight and completely at right angles to each other, all four of the main cusps would be in equal contact at the crossing place on the middle of the crown. But frequently cusps 1 and 4 crowd their neighbors a little and, gaining a small contact with each other, they prevent cusp 3 from being in contact with cusp 2. This whole arrangement of four cusps and two main grooves with the 1-4 contact has been called the "cruciform" or "plus-shaped" pattern of the lower molars.

In the first lower molar ( $m_1$  Fig. 1B) of all human races a fifth main cusp (5) is usually present behind 3 and

nearer the midline of the crown. In this five-cusped type the simple plus-shaped pattern is replaced by a more complex arrangement, the most conspicuous feature being a more or less irregular Y, the stem of which is the inner transverse groove between cusps 2 and 4, the fork being formed by the outer half of the transverse groove (between cusps 1 and 3) and by the deep oblique furrow between cusps 3 and 5. There is no 1-4 contact but there is a prominent 2-3 contact. Near the front border of the crown between cusps 1 and 2 there is frequently a prominent transverse groove or crack which has been called the "fovea anterior" (f.a.), while on the hinder inner border, between cusps 5 and 4, a smaller fissure is called the "fovea posterior" (Fig. 1C, f.p.). This whole pattern of five main cusps, with the longitudinal and Y-shaped grooves, the 3-2 contact, the foveæ anterior and posterior, in 1916 was named by one of us the "*Dryopithecus* pattern" of the lower molars, for reasons that will appear later.

While there is a great variation both in the sizes and in the patterns of all the molars in modern races, the first molar is apt to be larger than the second, and it almost always tends to have five cusps and preserves more or less clearly the "*Dryopithecus* pattern" (Fig. 2). The second molar, especially in the white race (Fig. 1A) is apt to have only 4 cusps and the "plus pattern." The third molar, which is

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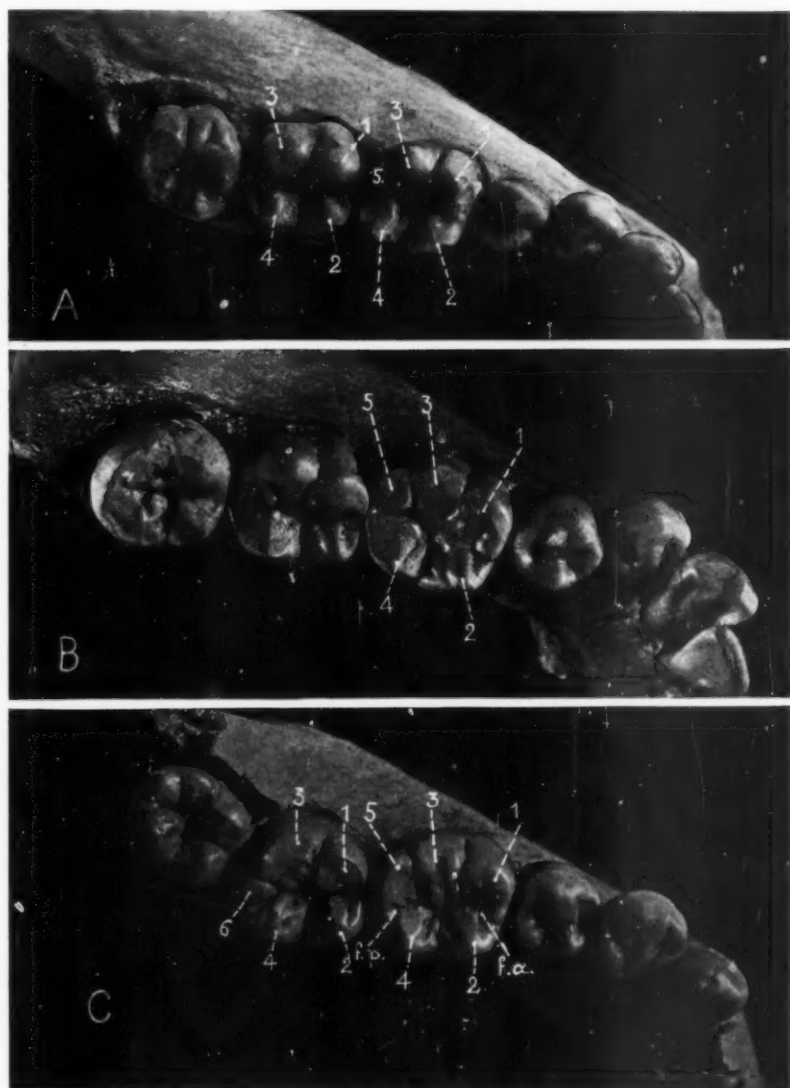


Fig. 1.—Human lower teeth, left side, showing arrangement of cusps in molars. A, White; B, C, Indian. Compare the arrangement of the cusps in the anthropoids (Fig. 2).

delayed in its eruption in the white race (Fig. 1A,  $m_3$ ), is often smaller than  $m_2$  and more or less irregular in outline, usually with a 1-4 contact and irregular plus pattern. In Negroes the third lower molar usually erupts somewhat earlier in life; it is larger than in the whites and frequently

retains five cusps and clearer traces of the "*Dryopithecus* pattern." With minor differences much the same conditions prevail in Australian aboriginals.

On all three molars of some races, such as Negroes, Australian aboriginals and Indians, a sixth cusp (Fig. 3D, 6) often appears on the middle of the

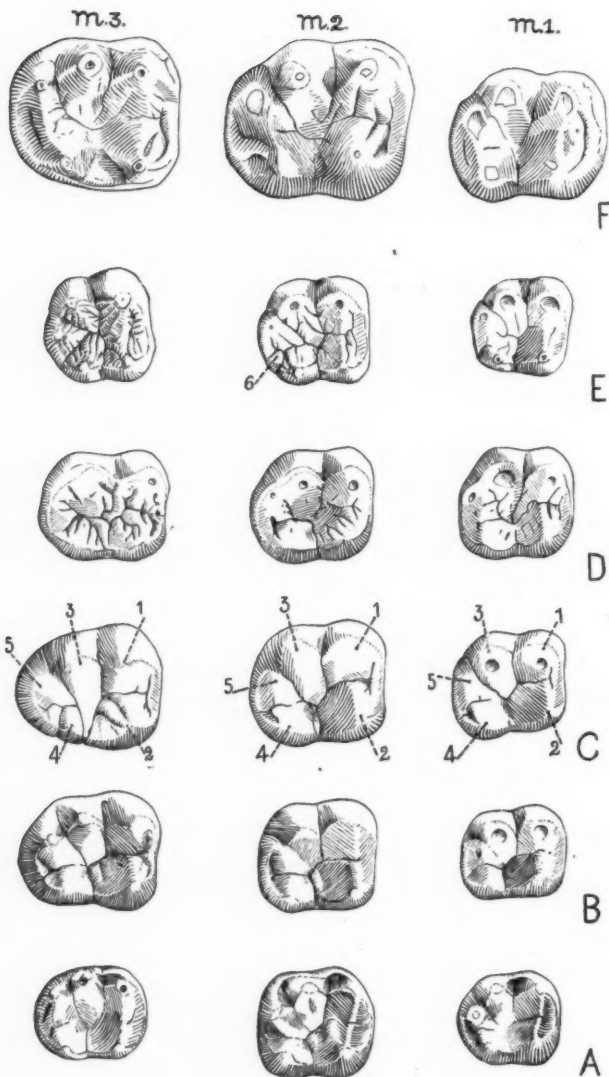


Fig. 2.—LEFT LOWER MOLAR TEETH OF FOSSIL AND RECENT ANTHROPOIDS. Drawing by Marcelle Roigneau.

F, Recent gorilla, Africa.

E, Recent chimpanzee, Africa

D, Recent orang-utan, Asia.

C, *Dryopithecus frickæ*, Miocene India.

B, *Dryopithecus cauleyi* from the Miocene of India.

A, *Dryopithecus fontani* from the Miocene of France and Spain.

hinder border and lying either between cusps 5 and 4 or in  $m_2$  between 3 and 4.

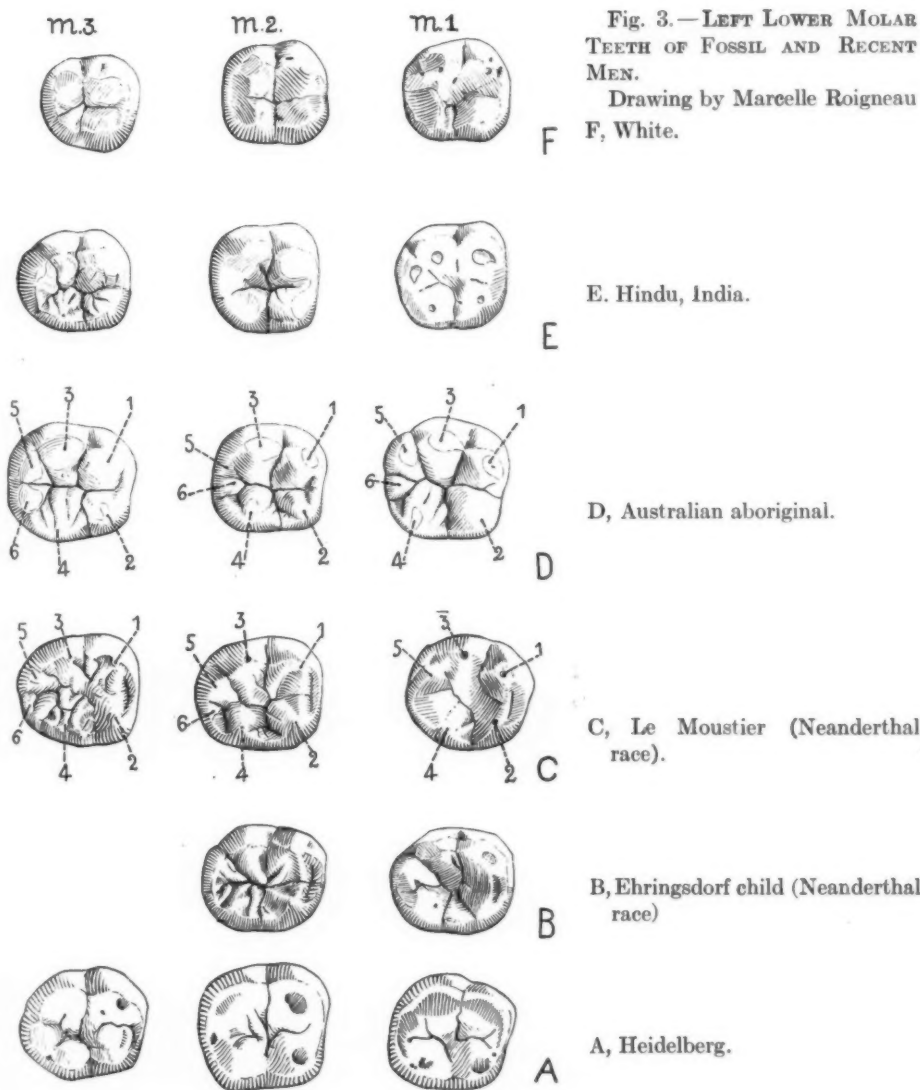
In the later post-glacial races of prehistoric men (Neolithic) the lower molar teeth, while well developed, do not differ conspicuously from those of recent races, but in the older races from the Upper, Middle and Lower Pleistocene of Europe (Cro-Magnon, Grimaldi, Mousterian, Ehringsdorf, Heidelberg, Piltdown) the lower molars vary from a modernized condition in

Cro-Magnon to a decidedly ape-like stage in Piltdown (Fig. 6). The lower molars of the Javan *Pithecanthropus* are unknown, but to judge from the curious mixture of human and orang-like details in its upper molars,<sup>1</sup> the lower molars should also have been more or less ape-like.

The very ancient Heidelberg jaw

<sup>1</sup>The evidence for this statement is given in *Amer. Mus. Bulletin*, Vol. XLVIII, pp. 527-530. 1923. "Further Notes on the Molars of *Hesperopithecus* and of *Pithecanthropus*," by William K. Gregory and Milo Hellman.





from the First Interglacial stage of the Pleistocene epoch, in respect to its retreating chin and extremely wide ascending branch may fairly be termed ape-like;<sup>2</sup> but its dentition is definitely human, although retaining a few primitive features. Thus the five main cusps (Fig. 3A) are present on  $m_1$ ,  $m_3$ , the *Dryopithecus* pattern is intact on  $m_1$ , there is a 3-2 contact on  $m_2$ . The

left  $m_3$ , is reduced, with a plus pattern; the right  $m_3$  is more primitive, with a 2-3 contact, with modified *Dryopithecus* pattern. To the palæontologist, possessing an intimate experience with the history of many mammalian lines during the Tertiary period, the fact that the Heidelberg teeth are definitely human while the jaw retains strongly ape-like features, can only mean that the first steps in the transformation of a generalized ape-like dentition

<sup>2</sup>See the diagram figures of ape and human jaws in plates XII, XIII, of Schoetensack's *Der Unterkiefer des Homo Heidelbergensis*. . . . Leipzig, 1908.

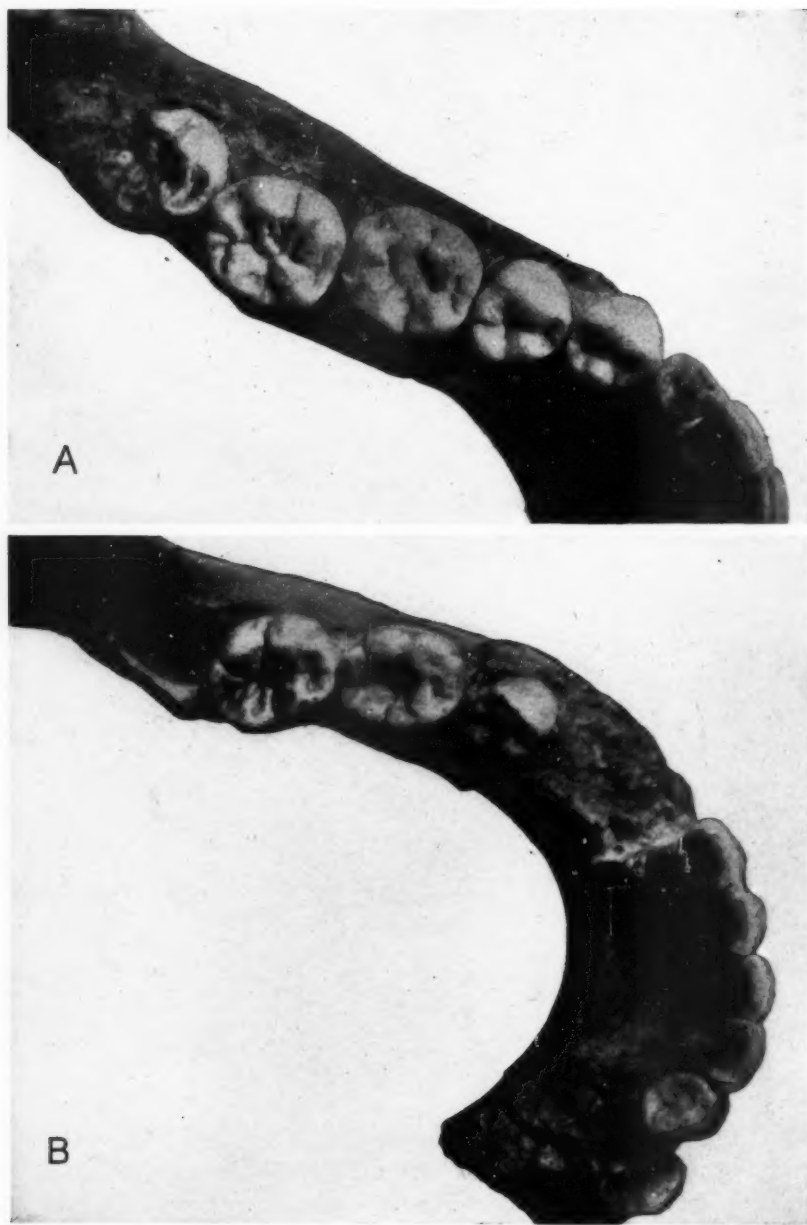


Fig. 4.—FOSSIL HUMAN LOWER JAWS OF THE NEANDERTHAL RACE.—A, Le Moustier. B, Ehringsdorf child. Photographs by Professor J. H. McGregor

toward the modernized human type must have taken place at a period far earlier than the Lower Pleistocene age of the Heidelberg man.

In the beautifully preserved denti-

tion (Fig. 4A and 3C) of the famous "Mousterian youth" of the Neanderthal race, the crown patterns are more or less obscured by the development of fine secondary grooves and wrinkles

rather suggestive of the conditions seen in certain chimpanzees and oranges as well as in the extinct ape *Dryopithecus rhenanus*. The modern plus pattern is conspicuously absent. On all three molars there are five main cusps, the 3-2 contact is undisturbed or emphasized, there are well developed foveæ anterior and posterior. A small cusp 6 is present on  $m_2$ ,  $m_3$ . The third molar, just erupting at the time of death, has a prominent fovea anterior; the surface of the crown bears numerous secondary grooves and wrinkles.

In the "Ehringsdorf child" (Fig. 4B and 3B) the first molar crown is decidedly narrower in proportion to its length than is the case in typical modernized molars. The second molar is also relatively very long and narrow. Both molars have a very large conspicuous fovea anterior, a good 3-2 contact, a fovea posterior and an irregular Y-shaped groove. In  $m_2$  there is a small accessory transverse groove and ridge on the inner half of the crown between cusps 2 and 4. Exactly this combination of characters is found in certain lower molars of *Dryopithecus rhenanus* from the Pontian (Lower Pliocene) of Europe (Fig. 9D).

The famous Piltdown jaw<sup>1</sup> from the Lower Pleistocene of Sussex, England, is in general so ape-like (Fig. 5B) that certain authors, including one of us, formerly refused to admit that it belonged with the undoubtedly human, though in some points very primitive, Piltdown skull. But the discovery<sup>2</sup> of a second lot of fragments in the Piltdown gravels, consisting of a lower molar (Fig. 6B) closely resembling the

first lower molar of the original specimen, associated with pieces of the forehead and occiput, appear to afford strong new evidence for Dr. Smith Woodward's original opinion that the ape-like lower jaw represents an extremely ancient and primitive species of mankind.

What evidence do the crown patterns of the Piltdown lower molars yield on this interesting question? In both the original specimen and the later-found one (Fig. 6) the crown of the first lower molar shows the much worn surfaces of cusps 1, 3, 5, 2 and 4, and clear traces of the Y-shaped groove. Cusp 4 was not enlarged and is widely separated from cusp 1, the 3-2 contact being well established. Foveæ anterior and posterior are both present. The second lower molar is distinctly longer and larger than the first.

It will be seen that on the human side the conditions in the Piltdown lower molars are perhaps most nearly approached in the Ehringsdorf jaw. But in another direction the crown pattern of the Piltdown molars, as thus described, is identical with that of all the known species of the extinct apes named *Dryopithecus* and allied genera from the Miocene of Europe and of India. Here will be seen (Figs. 2, 7) the identical arrangement of five main cusps, Y-shaped groove, foveæ anterior and posterior, etc., to which the name "*Dryopithecus* pattern" was originally applied. Moreover, all the modern genera of anthropoid apes (Fig. 2) inherit this pattern intact but with diverse modifications.

What is the explanation of the fact that the *Dryopithecus* lower molar pattern, first foreshadowed in the very primitive gibbon-like genus *Propliopithecus* (Fig. 8B) of the Lower Oligocene of Egypt, flowers out during Miocene

<sup>1</sup>See Dawson, C. and Woodward, A. S. 1913. "On the Discovery of a Palaeolithic Skull and Mandible in a Flint-bearing Gravel overlying the Wealden (Hastings Beds) at Piltdown, Fletching (Sussex)," *Quart. Journ. Geol. Soc.* Vol. lxix, pp. 117-151, pls. xv-xxi.

<sup>2</sup>See Woodward, A. S. 1917. "Fourth Note on the Piltdown Gravel, with Evidence of a Second Skull of *Eoanthropus dawsoni*," *Quart. Journ. Geol. Soc.* Vol. lxxiii, pp. 1-10, figs. 1, 2, pl. i.

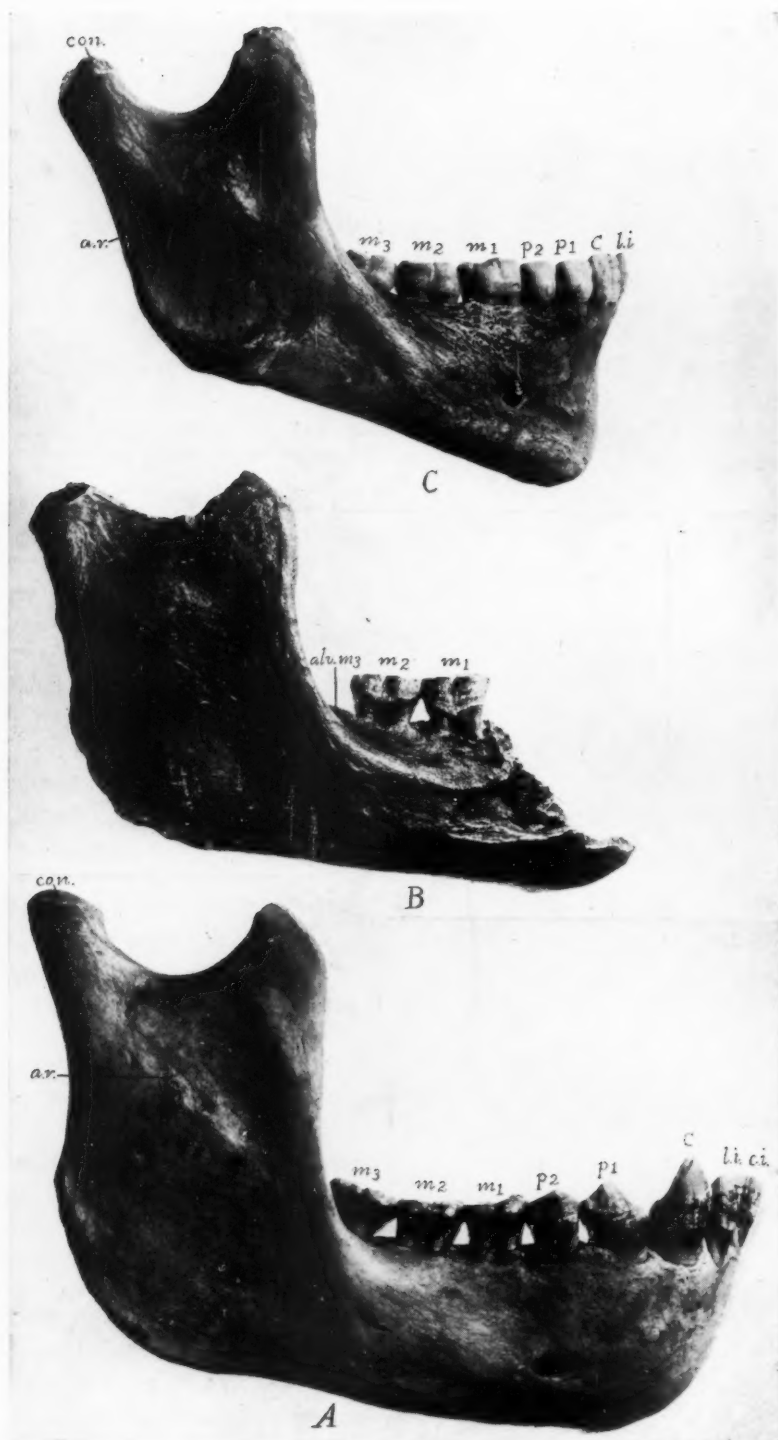


Fig. 5.—Lower jaws of orang-utan (A), Piltown (B), and modern man (C)

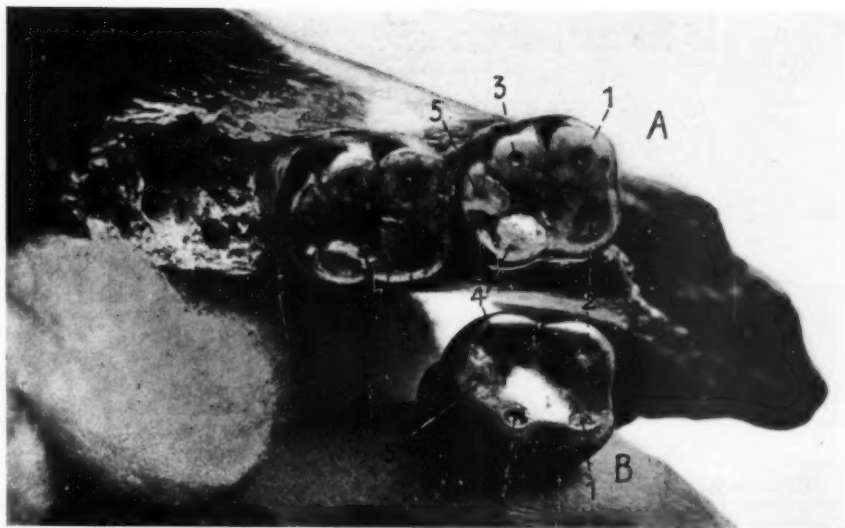


Fig. 6.—LOWER MOLARS OF THE PILTDOWN JAW, MUCH WORN BUT SHOWING THE PURE “*Dryopithecus* PATTERN.”—A, The first specimen. B, The second specimen. The photographs, by Professor J. H. McGregor, are reversed to facilitate comparison with Fig. 7.

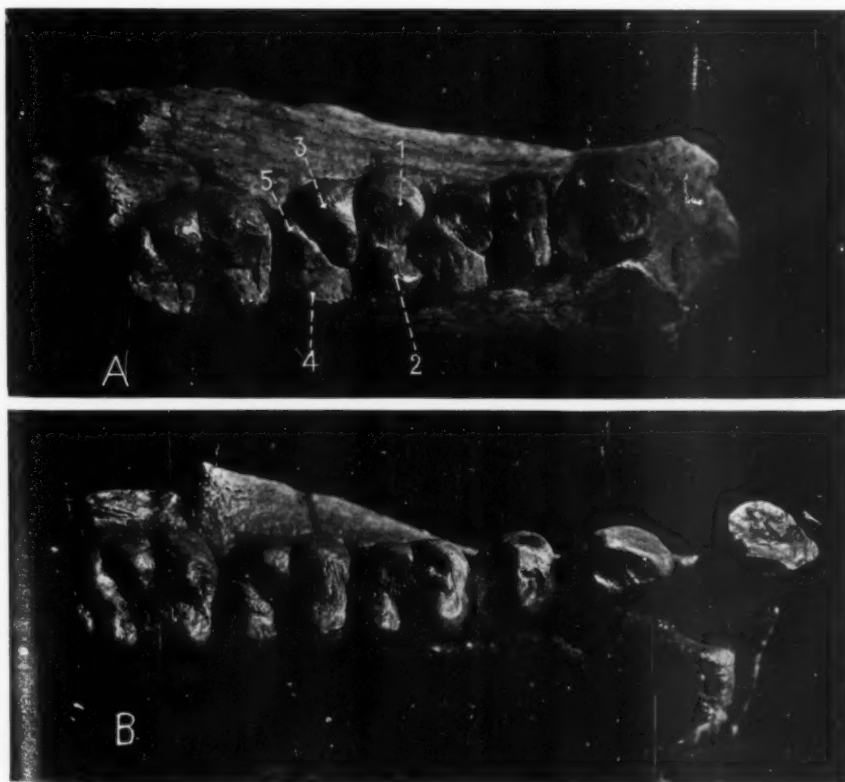


Fig. 7.—LEFT LOWER CHEEK TEETH OF FOSSIL ANTHROPOID *Dryopithecus*.—Collected by Barnum Brown, leader of the American Museum Expedition to the Siwaliks, India. A, *Dryopithecus frickæ*, Miocene, India. X  $\frac{3}{2}$ . B, *Dryopithecus cauleyi*, Miocene, India. X  $\frac{3}{2}$



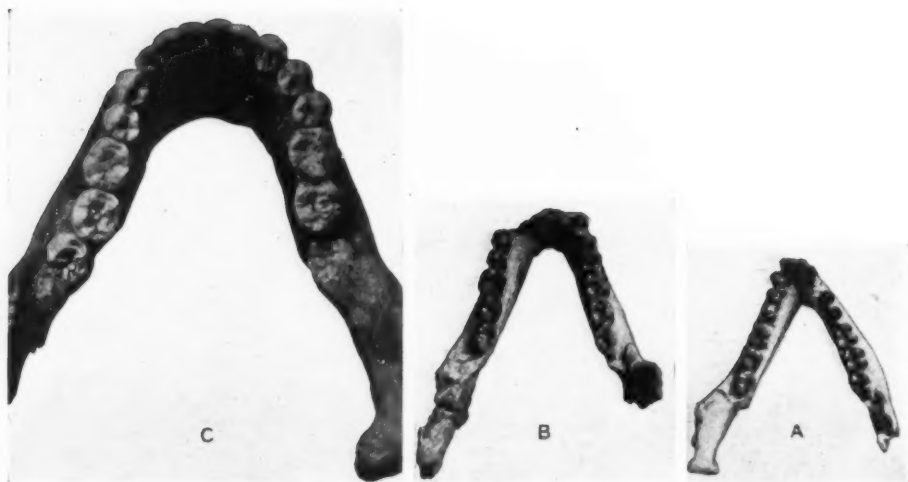


Fig. 8.—Three structural stages in the evolution of the human lower jaw. A, Primitive tarsoid stage (*Parapithecus*) with narrow space for the tip of the tongue and converging tooth rows. Lower Oligocene, Egypt. B, Primitive anthropoid stage (*Propliopithecus*) with nearly parallel tooth rows and wider space for the tongue. C, Primitive human stage (Le Moustier) with very wide space for the tongue and reduced and crowded front teeth. Photographs by Professor J. H. McGregor

times in many specific forms in the wide-ranging fossil anthropoid apes of Europe, Asia, and Africa, is present in its completeness in the Lower Pleistocene Piltdown jaw, and becomes more or less obscured in the Heidelberg, Neanderthal and later races of man?

Why do the upper molars of the Mousterian youth (Fig. 9A, B) exhibit such an astonishing agreement in ground plan with the upper molars of *Dryopithecus rhenanus* (Fig. 9C) from the Upper Miocene of Europe? And why are the second lower pre-molars of the Neanderthal and Ehringsdorf jaws most obviously composed of parts that are strictly comparable with those of the second lower premolar of *Dryopithecus*? (Figs. 4, 7.)

Why is it that in some chimpanzees the first lower premolar is a compressed, two-rooted tooth that retains much of the form of the corresponding tooth in the ancient *Dryopithecus*, while in some other chimpanzees the first lower pre-

molar is a transversely widened single-rooted tooth that is strongly like a human first bicuspid? Why does the lower first premolar of *Pithecanthropus* and of some Negroes and Australians retain two distinct roots, and why are these roots fused into one in modernized jaws?

Why is it that the canine tooth of the Piltdown jaw is essentially similar to that of *Dryopithecus*? Why are the lower incisors of the Mousterian and Ehringsdorf jaws comparable in fundamental characteristics of root and crown with those of modern gorillas?

Why are all the milk teeth of even modern man basically identical in their several patterns with those of corresponding teeth of modern anthropoids?

Why is the dental formula  $I_{\frac{2}{2}}, C_{\frac{1}{1}}, Pm_{\frac{2}{2}}, M_{\frac{3}{3}}$  (meaning two incisors, one canine, two premolars, three molars on either side and in both upper and lower jaws) exactly the same in all fully

developed normal adult dentures of men, anthropoid apes, and Old World monkeys?

And why are the dental formulæ different from this in all other groups of recent Primates?

Why is the formula for the milk teeth ( $dI_2^2$ ,  $dC_2^2$ ,  $dP_2^2$ ) also the same in all human races, in all anthropoid apes, and all Old World monkeys?

All these and a thousand similar questions might fairly be put to those

who, ignoring the convergent evidence of comparative anatomy, physiology and psychology, mammalogy, palæontology, and the like, persistently denounce as untrue Darwin's inference that man and the modern anthropoids, in spite of widely divergent specializations, have inherited their innumerable structural and physiological correspondences from some very primitive and early member of the anthropoid group of Old World Primates.

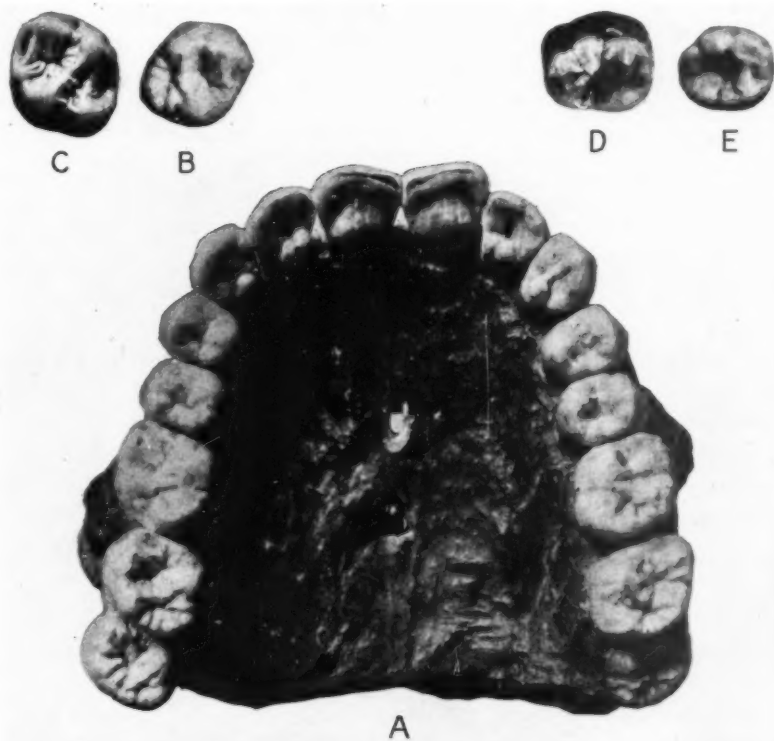


Fig. 9.—Anthropoid heritage in early human dentition.—Palate of Le Moustier (A). Comparison of second right upper molar of Le Moustier (B) with second left upper molar of fossil anthropoid *Dryopithecus rhenaus* (C). Comparison of first left lower molar of *Dryopithecus rhenaus* (D) with first left lower molar of Ehringsdorf child (E)

# Significant Characteristics of the Neanderthal Foot

By DUDLEY J. MORTON, M.D.

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Department of Surgery, Yale University, New Haven

THE outstanding characteristic by which the human foot differs from the feet of all other mammals is its large and *distinctive development of the inner border*. Study of the foot structure in all forms of animal life demonstrates that a hypertrophy or increased growth of this nature is always located along the functional axis of the foot. That phenomenon is conspicuously seen in the single metatarsal and digit of the horse, where the functional axis has coincided with the mid-line of the foot; or, in the two-toed condition of cattle and deer, where the functional axis lies between the third and fourth metatarsal bones and digits. In the human foot the presence of a similar increased development along the inner border makes it necessary for us to discover some peculiar structural condition which would cause the centrally-located leverage axis in the primitive type of foot to become displaced upon the inner border.

In all the forms of animal life there is but a single and isolated group which shows a structural arrangement that would fulfill this requirement. This peculiar formation is restricted to the anthropoid apes where it is a constant and well-developed character; the structural character referred to consists of an abrupt inward slant of the calcaneal (heel) joint surface, that is, of the facet upon which the astragalus (ankle bone) rests. The obvious and inevitable effect of such an obliquity, as shown in the gorilla (Fig. 1A), is to

deflect the body weight strongly upon and against the inner side of the foot.

But as the slant of this joint surface depends upon the actual position in which the heel bone is held, it now becomes necessary for us to determine definitely the position which this bone occupies in relation to the ground, when weight is borne upon the foot. This, however, presents no unusual difficulty. Examination of the posterior face of the heel bones of monkeys, apes, and other primates, as well as of mammals of other orders, shows that in a functional pose the axis of the posterior surface of the heel bone invariably lies in line with the pull of the attached muscles; and, as these muscles parallel the leg bones, the pull cannot be other than along a vertical plane in direct opposition to the force exerted by gravity.

Thus, when we place the gorilla, the Neanderthal, and the modern human calcanei (Fig. 1) in a position where the posterior heel axes are vertical, although the Neanderthal facet closely approaches the level position it occupies in the modern type of heel, nevertheless, it shows a distinct inward slant suggestive of the anthropoid condition.

Another intermediate character of the Neanderthal foot is the course taken by the tendon of the long flexor of the great toe. (Fig. 2A Fl.h.). In the anthropoid foot, the shelflike projection (*sustentaculum tali*, Fig. 2A S.t.) which helps to support the ankle bone, points obliquely downward so that the flexor tendon and its groove

hug the base of this process; the tendon is continued up behind the astragalus to lie in another groove located well to the *outer* side of the central point on the posterior aspect of that bone. In modern man (Fig. 2C) the under

plainly seen, occupying intermediate positions both on the heel and on the ankle bones.

Why and how does the obliquity of the heel facet influence the characteristics of the fore part of the foot? Be-

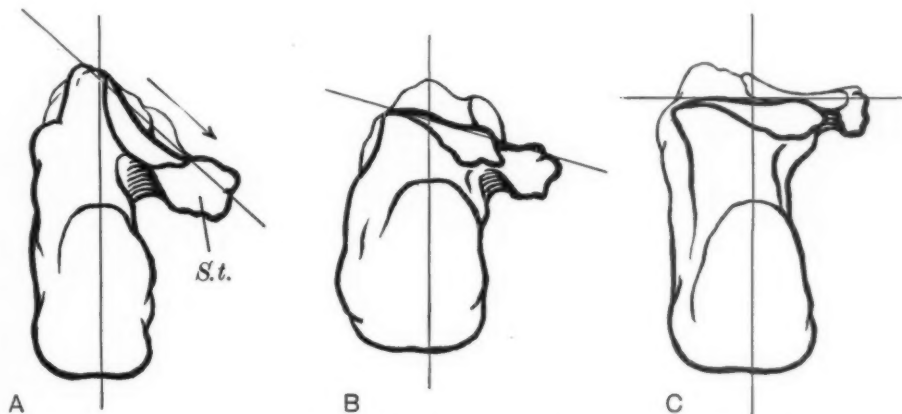


Fig. 1. Posterior view of left calcanei (heel) of gorilla (A), Neanderthal (B), and modern individuals (C), showing slant of sub-astragalar joint and shelflike sustentaculum tali. (S.t.)

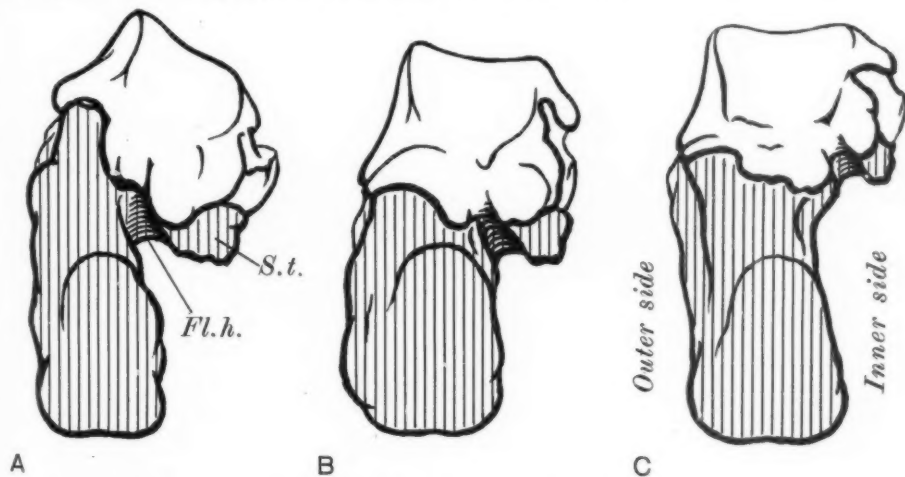


Fig. 2. Left calcanei of gorilla, Neanderthal, and modern individuals, with astragalus (ankle bone) superimposed. Fl.h. groove of long flexor tendon to the great toe

surface of this shelflike process slants upwardly, so that the tendon with its groove has shifted toward the tip of the process; also the groove on the astragalus has moved to the *inner* side of the central point.

In the Neanderthal bones, the grooves for the flexor tendon are

cause it determines the manner in which the stresses induced by body weight are distributed throughout the foot; consequently, we may expect corresponding effects to be shown in the proportions and structural relations of all the elements of the foot. This we will now find to be just what happens.

The fact that man shares with some of the larger anthropoid apes, alone among Primates, the peculiar position of the main axis of weight (which lies along the inner border of the foot) is entirely consistent with the view that

ciently thorough analysis of the foot structure in the Primates.

Recognizing that the unique obliquity of the calcaneal facet in the anthropoid ape foot is the only structural condition which would ensure the

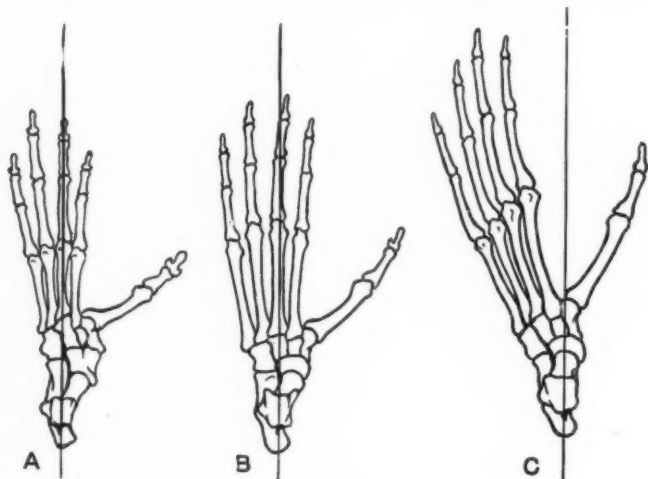


Fig. 3. The primitive functional axis as shown in (A) the lemuroid (*Lepidolemur*) and (B) simian (*Macaque*) types of feet; also the inward displacement of the functional axis (C) in the gibbon, the most primitive of living anthropoid apes

From *Jour. Bone and Joint Surgery*

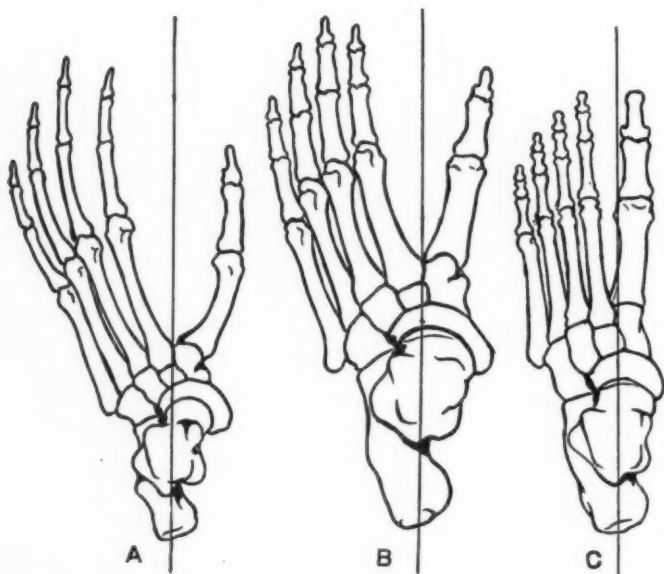


Fig. 4. Foot bones of (A) arboreal chimpanzee, of (B) ground-living gorilla, and of (C) man, showing increased development along the inner border of the foot and more massive heel, as a result of terrestrial usage

From *Jour. Bone and Joint Surgery*

the human foot has been derived from a primitive anthropoid foot, much like that of the chimpanzee. This view has been abundantly supported by much independent testimony from many sources and is accepted by practically all anatomists who have made a suffi-

ciently thorough analysis of the foot structure in the Primates. The short functional axis being thrown along the inner border, we may provisionally regard the arboreal chimpanzee foot (Fig. 4A) as in a general way representing the type to be found in the ancient primate stock from which the human stem was derived. The short



divergent hallux (great toe), the long digits, the slender metatarsal bones, and relatively small heel of the chimpanzee foot, are typical of its arboreal character.

The next stage which was one of the early terrestrial modifications, clearly demonstrates the effects of the sub-astragalar slant. The structural peculiarities of the feet of certain ground-living species of gorilla (*Gorilla beringei*) give unmistakable evidence (Fig. 4B) of the deflection of body weight against the inner border of the foot. The hallux has become notably increased in length and stoutness; the second metatarsal bone also has received a distinctly more robust development than the three outer ones. The reduction of the grasping function of the foot has permitted a shortening of the digits, but the hallux or great toe still retains its wide divergence. In place of the grasping function, however, the hallux, has now found a new, useful purpose in its divergence by acting as a buttress to stabilize the foot against the strong inward deflection of body weight; hence, its divergence would naturally be retained as long as the oblique position of the sub-astragalar joint persisted. The heel has acquired more massive proportions.

It is pertinent to note here that the foot skeleton of a captive chimpanzee which has come under my observation, shows similar gorilloid changes especially in the increased stoutness of the second metatarsal bone. The modifications which have taken place in this pair of feet, clearly differentiate them from the feet of native tree-living individuals, and give strong corroboration to the terrestrial character of the changes in the gorilla feet which I have just described.

The modern human foot presents

very different characteristics, but the differences are essentially a matter of degree only. In the absence of a lateral inclination of the sub-astragalar joint, the foot has acquired what medical men call its "balance." Consequently instead of body weight being concentrated upon the inner border, it is more evenly distributed over the entire foot. The previously acquired hypertrophy of the hallux has been retained, even amplified; but in addition, we note a definite increase in the development of the fifth metatarsal bone, especially in its nearly vertical diameter. The characteristic arching of the human foot is the outcome of a remodeling of the bones in such a manner as to produce its balanced posture. At the same time this remodeling gradually eliminated the inward deflection of body weight, and the great toe was brought to its present position parallel to the second toe. Here it assumed more and more of the burden of the second metatarsal bone so that now the latter presents a relatively slight build. The massive heel of the human foot is merely a continuation of terrestrial modifications which had progressed to a notable degree in the gorilla.

The correlation of the position occupied by the anthropoid and human sub-astragalar joints, with the associated characteristics in the forepart of the feet, enables us to predict certain peculiarities of the Neanderthal foot which Professor Boule has either not noted in his writings or has mentioned but briefly. He speaks of the lowness of the arch in the Neanderthal foot—a condition which the slanting position of the shelflike sustentaculum tali would lead us to foresee. This obliquity would indicate a corresponding degree of divergence of the great toe because of the associated inward de-

flection of body weight. This point also, he has covered by stating that the basal joint of the hallux showed a greater curvature than is present in the foot of modernized man. But accompanying that divergence, there should be a definitely *increased stoutness of the*

an impossible action. Also, as the posture he gives would have the effect of eliminating the deflection of body weight upon the inner border of the foot through a leveling of the sub-astragalar joint, the functional axis through the foot would inevitably fall

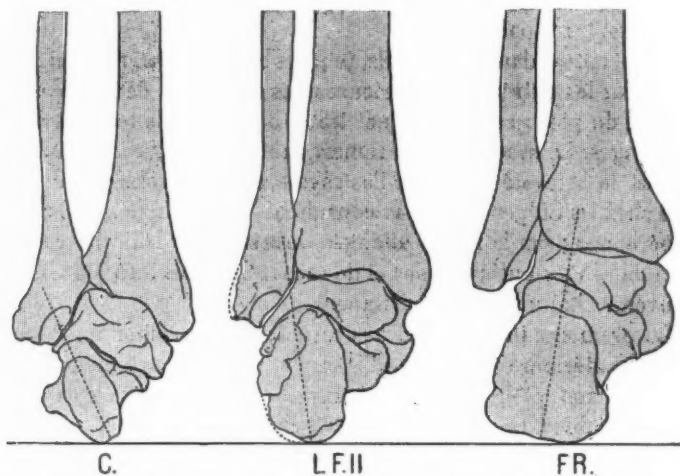


Fig. 5. Posterior view of the heels in (C) chimpanzee, (L.F.II) La Ferrassie II, and (F.R.) modern man, as suggested by Boule. While giving the Neanderthal an intermediate status, Boule apparently determines the position of the calcanei by levelling the sub-astragalar facets instead of placing the heel axes vertically. After Boule

*second metatarsal bone* which he does not mention; also the fifth metatarsal bone should be of comparatively lighter build and more rounded in its transverse section—not so vertically ovoid as in the modern foot—another feature which he does not disclose in his writings.

In Professor Boule's illustration (Fig. 5), the axes of the heels are thrown at different angles instead of being placed vertically. His arrangement is very misleading. He shows the human foot in a somewhat abnormal, although a very common, *pronated* posture. Likewise, the position in which he pictures the chimpanzee heel does not represent a terrestrial weight-bearing posture. The position of its axis would indicate that the pull of the calf muscles was obliquely outward—

upon the outer border. The fact that it is the inner border of the anthropoid foot which invariably becomes hypertrophied under terrestrial conditions and not the outer, is structural evidence which absolutely demonstrates the fault of his premise.

On the other hand, the sequence that I have shown here representing the principal characteristics of four successive evolutionary stages (arboreal anthropoid, terrestrial gorilloid, Neanderthaloid and modern human) is a natural one and seems to be the only sequence which will successfully withstand critical analysis from the standpoint of the mechanics involved. Moreover, it conforms with the great mass of accumulated evidence which definitely unites human origin with an ancient arboreal anthropoid stem.

# Taungs and Its Significance

By RAYMOND A. DART

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**M**AN is an omnivorous, bimanous, and bipedal, almost erect, terrestrial mammal. The highest living anthropoid apes are frugivorous, quadrumanous (or quadripedal), semi-arboreal, semi-erect mammals. It is believed that man arose from a semi-arboreal ancestor, to which the highest living apes are the nearest mammalian relatives, and that this semi-arboreal ancestor sprang, in turn, from an ancestor who was entirely arboreal in habit. Indeed, there are those who believe, that not merely man and all his near relatives, the Primates, but the whole mammalian stock came from ancestors who at one time lived entirely in the trees. We are not concerned here with this more remote origin of the Primates other than to note that they are tree-livers and that their ancestors were tree-livers from the earliest mammalian times.

In order to achieve his so-called erect posture and terrestrial mode of life, the monkey that was to be man had to pass through a severe apprenticeship, of which there were two initiatory phases, before he entered the third phase or true freemasonry of manhood. These two phases were firstly, the semi-arboreal (or semi-terrestrial) which is typified by the living anthropoid ape; and secondly, the entirely terrestrial man-ape phase which has been hitherto typified by one representative only—the man-ape of Taungs, found in Bechuanaland, South Africa.

It has long been recognized by naturalists that two such phases in man's evolution were probable; of the

first phase we have in the four living anthropoids and many extinct ones a great deal of information concerning not only its essential characteristics but also its site of operation, i.e., in the tropical or subtropical forest zone. The second phase has been appreciated only as a theoretical necessity, and the scene of its occurrence has been purely a subject of conjecture.

The Taungs remains show that this second phase was a living reality; they demonstrate that man did not arise "Minerva-like in full panoply" as a sudden sport from some semi-arboreal ape, but that the anthropoid achieved human status by laborious passage through the terrestrial man-ape phase; finally they indicate, if they do not actually prove, the quarter of the earth upon which this penultimate act in the drama of humanity was staged.

It is in these matters that the Taungs remains have their significance. They have rendered real what hitherto has been theoretical. We will discuss certain evidence which demonstrates the nature of the body, habits, and mentality of the group of beings the remains have portrayed to us.

## THE PLACE AND THE BARRIER

The Taungs limestone deposit is a cliff at whose feet, to the east lies the treeless (save for shrubs) valley of the Harts River and whose plateau crest, equally devoid of forest stretches west into the Kalahari desert. The temperature at Taungs fluctuates from 120° F. in summer to severe frosts and biting cold winds in winter. The



Fig. 1. *Australopithecus*, right side view of the skull

average annual rainfall is about five inches.

It is an area which impresses one, by its heat in summer, and its cold in winter, and by its lack of rain, of woods, of grass, of running water, and all things delectable, as the most inauspicious spot for man's forerunners. It is a region once thickly populated by Bush people and is now a native reserve occupied by a bastard Bush-Bantu race of Bechuanas. But areas such as this, habitable by mankind through his

adaptability, his intelligent use of weapons, and his quickness of movement, are not habitable by the lumbering anthropoids of the tropics.

Hence, the appearance of *Australopithecus*, roughly on the latitude of Johannesburg, was most unusual and unexpected and can be explained only by the fact that *Australopithecus* had partaken of those characteristics which separate man from the anthropoids and make it possible for him to exist in such untoward environments. This



Fig. 2

Fig. 2. *Australopithecus*, right side, cast of skull with restored outline of flesh



Fig. 3

Fig. 3. *Australopithecus*, left side reconstruction

belief that *Australopithecus* profoundly differed from modern apes becomes more reasonable when we consider the geographical situation of Taungs. Lying in the Orange River watershed, it is separated from the Zambesi watershed by a vast open tract of country which, to the west, (from Western Rhodesia to the Atlantic Ocean) is the Kalahari desert, and to the north and east (throughout Rhodesia and the Northern Transvaal) is occasionally wooded but is mostly treeless prairie or veldt country. There is no woodland approach to Taungs from the north, east, or west. This open and in large part barren country, interposed between the tropical forest and Taungs is, and has been from Cretaceous times, an effective barrier against the migration of the semi-arboreal anthropoids of Africa—the chimpanzee and gorilla.

The efficiency of this barrier against the migration of the living anthropoids cannot be stressed too greatly when we

call to mind the fact that during Tertiary times that barrier of desert and plains has been effectively reinforced by the fearsome carnivorous enemies of Primates, whose possession it was. It is obvious, *prima facie*, that the Australopithecoid group which forced this barrier into the remote Southland had evolved an intelligence (to find and subsist upon new types of food and to avoid the dangers and enemies of the open plain) as well as a bodily structure (for sudden and swift bipedal movement, to elude capture) far in advance of that of the slothful, semi-arboreal, quadrupedal anthropoids. They had thus attained a degree of physical and psychical advancement that sundered them irrevocably from their tropical cousins. It is equally clear that those who had successfully traversed the barrier and established their capacity to live in the latitudes of the Vaal had no serious barrier interposed between them and



the southern extremity of the continent.

We may therefore reasonably indulge the greatest hopes of the discovery of youths and adults of the same and allied species in any part of Southern Africa, especially the Eastern coastal areas where the climatic and botanical conditions are so much more amenable for Primate existence.

The formidable nature of the land and animal barrier together with the vicissitudes of life, to which this Australopithecoid group was continually exposed in this country, is the more important to bear in mind since the factors which evoked the thinking and planning powers of the anthropoid, and, with these powers, caused the transformation from anthropoid to man, are to be sought, not in any cataclysmal upheavals of nature, or fortuitous saltations of the germ plasm, but rather in steadily and continuously operating environmental conditions which constantly and increasingly demanded the operation of choice and cunning.

Such an environment is certainly not to be found in any land belt containing the easy refuge of trees where the return to semi-arboreal existence was possible as, for example, throughout Southern Asia and the Eastern Indies.

Just as for the expansion of the brain so, for the evolution of a more erect posture, in which reliance would be placed upon the feet and not at all upon the hands, it was essential that a large territory should be available in order to make it impossible to return to the forest. In this way the anthropoid group should be committed over a countless number of years to the use of their upper limbs for fight and their lower limbs for flight. An environment of this type was present, because

of the barrier already mentioned, from Cretaceous times onward in Southern Africa; and Southern Africa is the only country which has elicited, hitherto, an anthropoid individual betraying features such as one might expect to result from the operation of these unremitting and compelling environmental conditions.

I have dealt in some detail with the question of the barrier and the environment it provided, not merely because I was unable to devote more than passing attention to it in my preliminary discussion of the Taungs man-ape, but also because I feel that certain of the criticisms that have been made of my conclusions have been prompted by a failure to appreciate the presence of this barrier and the unquestionable nature of the results which the barrier and the terrestrial life, to which it committed them, must have had upon the bodily form of an anthropoid group which, prior to their leaving the forest, were semi-arboreal in habit. If we had possessed no endocranial cast and, consequently, no corroborative evidence concerning the increased intelligence, the better use of the hands and the more erect stature of this group of creatures from the actual remains themselves, these matters might reasonably have been inferred from a consideration of the geographical site at which the discovery was made.

#### THE CAVERNOUS FORMATION AT TAUNGS AND THE HABITS OF *AUSTRALOPITHECUS*

It has been suggested that the skull may have been washed into the cave from the surface in comparatively recent times. This view cannot be admitted for several reasons. In the first place the lower jaw is so closely associated with the upper jaw (being

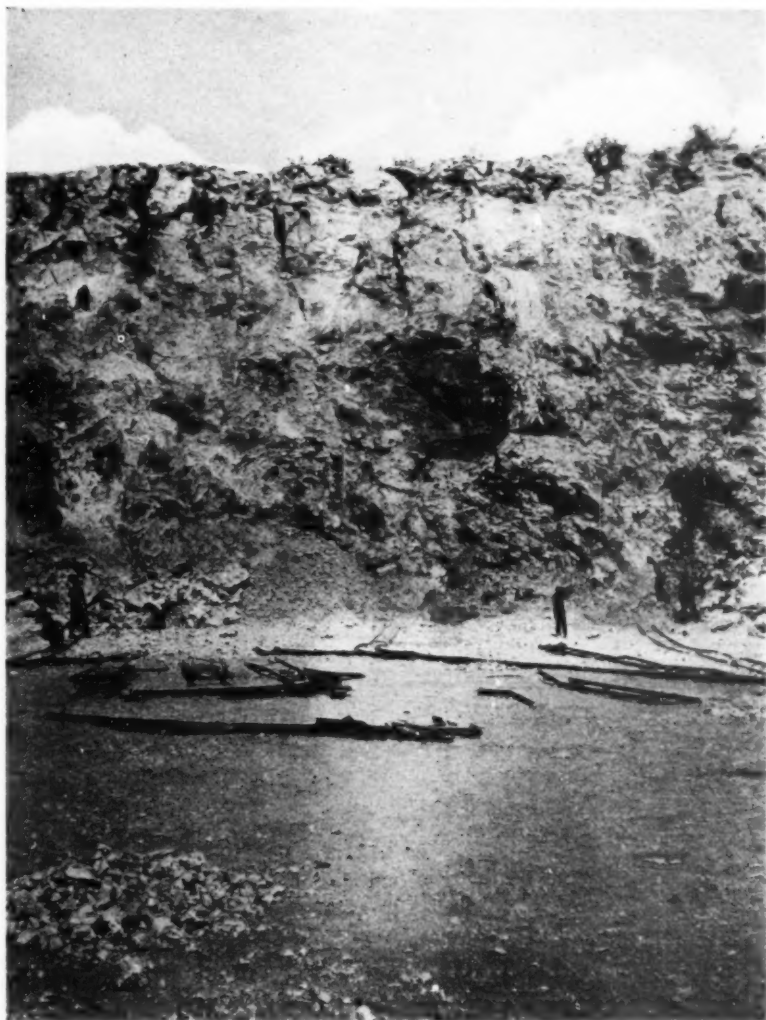


Fig. 4. Face view of the Taungs limestone cliff, showing the cavern in whose solidified floor (X) the Taungs skull was found

only displaced some 2 mm. forward) that a rolling of the remains over a distance and a fall of fifty feet into a cavern, to which no vertical opening has been demonstrated, is not seriously to be considered. Further, fragments of the distal ends of the forearm bones and of the phalanges were present in the rock mass from which the facial fragment was isolated. These proved too fragmentary and too friable to

develop but portions are still visible in the stone. These together with the completeness of the skull parts, argue most forcibly against any such conception of the history of the bones.

In the second place the accompanying fossil deposit was a limestone bone breccia containing hundreds of fragments of bone obviously gnawed and constituting a midden heap. It has been suggested by some that the



Fig. 5. Lateral view of the Taungs limestone cliff. The (X) marks the cavern where the skull was discovered

*Australopithecus* child was itself the prey of some larger carnivorous creature of which this deposit indicates the den. The absence of any bones of larger animals in that recess and the completeness of the Taungs remains is against such an hypothesis. On the other hand the material, which looks like the comminuted bones of turtles, birds, small insectivores, rodents, baboons, and perhaps small bok, as well

as birds' eggshells, indicates by its nature, its sparsity, and its searched over and exhausted character, the careful and thorough picking of an animal, which did not live to kill large animals, but killed small animals in order to live.

This conclusion was reached after many protracted searches by the mine operatives and myself for the accompanying fauna. The close association

of baboons with the Taungs skull has always been surprising and is still not satisfactorily cleared up. Many of the baboon skulls show signs of fracture before fossilization. Recently I have been successful in isolating, from the breccia, part of the innominate bone of a baboon which was broken, splintered, and probably chewed before fossilization. It is my opinion that we have in *Australopithecus* a troglodytic anthropoid which, in addition to, and probably because of its increased intelligence and its skill in using its hands as hands and its feet as feet, had become sufficiently weaned from its frugivorous tropical diet to vary its table with the fruits of the chase. Today the limestone cliffs are riddled with bees' and birds' nests. Small rodents, turtles, lizards, and other reptiles are plentiful. The Thabaseek "river" pools are filled with rushes drooping with birds' nests, and provide fish, amphibian and reptilian life in profusion. Wild game of the water and the veldt, though not so abundant today, previously existed there in great numbers.

In the third place, these brecciated deposits do not occur under conditions which lend weight to the hypothesis of their being washed in from the surface. They were not found along a tract communicating with the top of the quarry but in isolated and rigidly circumscribed patches like lairs. The small area of breccia in which the *Australopithecus* skull was found has long since disappeared entirely. Recently, in an entirely different area some fifty yards or more to the Southwest at about the same level, another finely comminuted breccia, also circumscribed in extent, has appeared. As there has been an extensive cavernous formation through-

out the limestone, the cavities represented by these patches of sand and sandstone probably communicated freely with one another in the remote past during which *Australopithecus* lived.

Considering the evidence impartially, I am led to believe that the man-apes of Taungs were terrestrial and troglodytic in character and that they were omnivorous, having already assumed the diet characteristic of primitive man in such places.

#### THE AGE OF THE DEPOSIT AND OF THE FOSSIL

With reference to the epoch at which the fossil was embedded in the limestone, there is bound to be much doubt until we know considerably more about the geology of the deposits themselves, and the general question of ageing deposits in Southern Africa. From a consideration, firstly, of the position of this specimen in the cliff; secondly, of the intensity of the infiltration of the lime to form the hard stone in which it was embedded; and, thirdly, of the fact that there is ample evidence in the cliff itself that sand was being incorporated in the cliff during the depositing of the lime, I am of the opinion that the limestone was deposited irregularly leading to the cavernous structure, and that the interstices were filling up with sand from a very ancient period, in large measure contemporaneously with the lime deposition.

In his notes on the baboons found at Taungs which he has kindly placed at my disposal, Doctor Haughton remarks, "It is certain that the sandy patches in the limestone and the bones embedded in them are of the same age as the main body of the limestone."

Since there was a certain growth for-



ward as well as in height during the lime deposition, both the horizontal depth (250 ft.) as well as the vertical depth (50 ft.) at which the remains lay have a degree of significance. In other words I look upon the fossil as Tertiary and embedded while the lime formation was still in progress.

Since that time a ravine about one hundred feet in depth and nearly three-quarters of a mile long has been worn through the hard calcareous tufa when it was the original course of the tiny Thabaseek "river," a sluit or creeklike tributary of the Dry Harts River.

Later the "river" was diverted to its present course northward of the tufa through the softer shales, and has worn its bed to a point some two hundred feet below the top of the cliff. How long it has taken for these processes to become completed it is difficult to say, but in view of the fact that years may elapse without any running water ever passing over the "waterfall" at the head of the gorge through the plateau's edge and along the stream bed, and the further fact that water rarely, if ever, is running during a whole week in any year that rain falls—when of course it may be a raging though small torrent for a couple of days—it is impossible that the work of erosion could have been rapid. It is hardly necessary to say that in the period during which the area has been known, i.e., the last half-century, no appreciable alteration of the conformation of the stream or its channel has been recorded. Assuming for the sake of argument a uniform rate of backward erosion of  $\frac{1}{8}$  inch per annum, it will be seen that some 125,000 years were necessary for the formation of the dry ravine which is from 50 to 250 feet broad—the cutting of the modern

river bed taking perhaps a somewhat briefer but additional period. At all events it is reasonable in the present state of our lack of knowledge to estimate the age of the river bed in terms of hundreds of thousands of years—possibly, as one has suggested, contemporaneously with the uplift of South Africa in the Pliocene. In any case the deposition of the lime deposits took place prior to that period, i.e., prior to the formation of the dry ravine and the present river bed, and so at a very remote period, probably pre-Pliocene. There is no evidence to indicate that the Taungs man-ape did not inhabit the district in those days of lime deposition.

The question must remain an open one on the geological side at present, but it is certainly sheer assumption to regard the deposit and the contained fossils as Pleistocene. Already four definitive human types are known from South Africa as fossils, Rhodesian, Boskop, Bush, and Bantu. All of these are distinctive types of mankind. They are essentially African in distribution and presumably locally evolved. It is true that Rhodesian man has Neanderthaloid affinities and that his geological age is uncertain, but that does not prove that he wandered southward from Europe. The discovery of Neanderthal bones in Gibraltar, Malta, and Palestine, the three gateways from Africa to the other continents, is evidence rather of the reverse migration. All the available evidence indicates that Africa is the fountain-source of her own peculiar stocks, the Rhodesian, Boskop, Bush, and Bantu races. She was probably the source of the Neanderthal stock, and Sergi has always regarded her as the source of the Mediterranean branch of the Caucasoid race. There can be no



doubt that the lapse of a great period of time was necessary for the elaboration in Africa of these primitive and modern types. The discovery of the contemporaneity of man with various extinct animals—hippopotamus, mam-

evidence, the examination of the associated fossilized baboons, which is proceeding here at the present time, promises to reveal the fact that the baboon fauna contemporaneous with *Australopithecus* was a different and



RHODESIAN

BOSKOP

BUSH

BANTU

Fig. 6. The four African types of primitive man

moth, giraffe, giant pig, and giant buffalo—corroborates this conception of man's antiquity in Southern Africa. The gravels of the Vaal Watershed, which are apparently of Pleistocene age, bear these records. It would be amazing if the Taungs caverns existed in Pleistocene times and were not occupied by man who, as far as can be learned from the study of stone implements, infested the whole Vaal valley during that period.

At Taungs itself, one can find ample evidence of human habitation throughout the vicinity in cave paintings, delicate stone culture and work in bone. But it is all superficial and in no case have human bones or implements of Bush people or of the remoter Boskopoid and Rhodesoid people been recovered from depth in those fissures and caverns in the limestone, for which some suggest a recent age. Until positive evidence of this type is forthcoming, one logically assumes that the deeper filling up of the fissures and the age of *Australopithecus* was anterior to the human period.

Apart from this general type of

more primitive type. Final conclusions have not as yet been arrived at, but it may be stated in general that at least two varieties of baboon were living at that time whose cerebral fissuration pattern was more primitive than that of living forms, and whose endocranial capacity was considerably smaller. There is, therefore, distinct promise that further discoveries and perhaps even those already made will prove that the deposits are of remote age, as the discovery of *Australopithecus* suggests in itself.

#### AUSTRALOPITHECUS AND MODERN ANTHROPOIDS

I have discussed the general question of the age of the Taungs deposits; it remains to make a few remarks about the fossil in comparison with modern apes. For this purpose I have had prepared three diagrams in which the cranial outline of *Australopithecus* is superimposed upon that of (1) an orang child of the same age, (2) a chimpanzee child considerably younger, in which the milk canines and first permanent molars are not fully erupted,

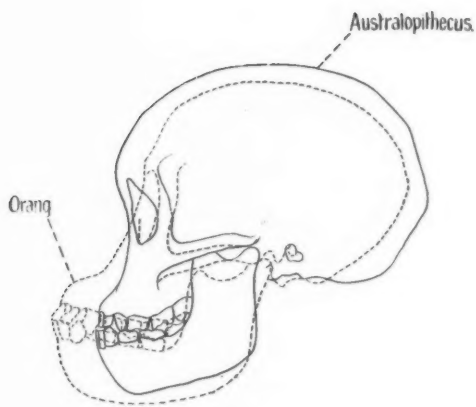


Fig. 7

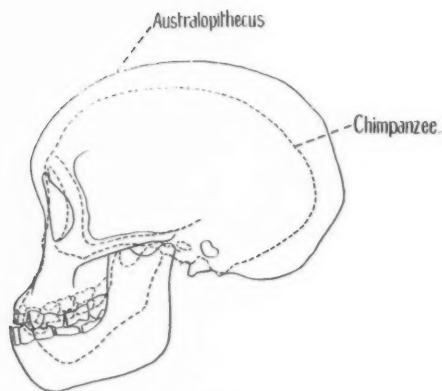


Fig. 8

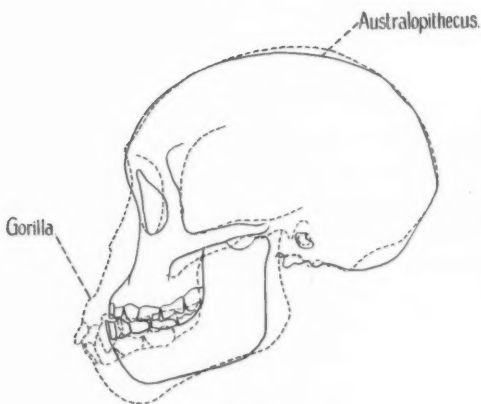


Fig. 9

COMPARATIVE DIAGRAMS ILLUSTRATING THE DIFFERENCES BETWEEN *Australopithecus* AND THE ORANG, CHIMPANZEE, AND GORILLA

Fig. 7. Superimposition of *Australopithecus* upon an orang child of the same age. Note the striking difference between the faces and brain cases of both and especially the overhanging forehead of *Australopithecus* as compared with that of the orang

Fig. 8. Superimposition of *Australopithecus* upon a younger chimpanzee child in which the first permanent molars are not erupted. Note the overhanging forehead and the absence of ridge over the eyes as well as the increased size of the brain case in *Australopithecus*

Fig. 9. Superimposition of *Australopithecus* upon a younger gorilla child in which the first permanent molars are not erupted. Note the smaller teeth and muzzle, the overhanging forehead and the absence of the ridges over the eyes in *Australopithecus*. This gorilla is selected for its unusual size of brain case

and (3) a large-brained gorilla child also younger and in which the first permanent molars are not erupted.

These diagrams are of interest because various scientists, according to individual preference, have claimed *Australopithecus* as an orang, or as a chimpanzee, or as a gorilla. In all the diagrams the skulls are oriented on the same axis (a horizontal line running through the lower margin of the eye-hole and the upper margin of the ear-hole). It is unfortunate that the young chimpanzee and young gorilla are not of precisely the same age as *Australopithecus* but they are sufficiently old to bring out the points I wish to make.

In the first place, in all living anthropoid apes there are definitely marked eyebrow ridges which are entirely absent in *Australopithecus*. All living anthropoids portray a jutting-forward of the muzzle and a falling back of the forehead; while in *Australopithecus* the forehead bulges forward and overhangs the nose and the muzzle to the extent that this feature occurs in some races of man himself.

If we examine the first figure it will be seen how enormously beyond the brain capacity of the orang lies that of *Australopithecus*. In the second figure we are struck once more by the disparity in brain volume between the chimpanzee and *Australopithecus*. The chimpanzee is of course young and its brain would grow a little in size before the first molar was attained but the cerebral disparity would still remain. On the other hand our diagram gives an erroneous impression concerning the small facial parts of the chimpanzee which have not developed to the size they assume when the first molar is erupted, and yet they are already relatively more projacent than the features

of the older *Australopithecus*.

In the third figure a large-brained gorilla child is compared with *Australopithecus*. Here, despite the size of the gorilla's brain, there can be seen its brutal overhanging eyebrow-ridges, retreating forehead, massive bones, enormous muzzle, jaws and teeth—features which would be even more pronounced were its first permanent molar erupted.

There is no need to elaborate here the width of the gap that lies between *Australopithecus* and the living anthropoids, for the differences that are seen at a glance spread to every detail of the cranial, facial, and hence also of the bodily make-up. The diagrams show that if *Australopithecus* has any relationships of size and form they are with the chimpanzee rather than with any other living anthropoid. It is consequently only with the chimpanzee that serious comparisons should be drawn in order to assess the nature of this extinct group of Primates.

Certain scientists seem to think that if the brain size of *Australopithecus* was not as great as that of some modern gorillas, *Australopithecus* is not to be thought of seriously as providing any evidence concerning man's ancestry. Nobody would seriously assert that mastodons, mammoths, and whales are more intelligent than man because their brains happen to be larger than man's. Their brains are larger because their bodies are so immense, for the same reason that a man's brain is on the average considerably bigger than a woman's. It is equally foolish to compare the brain volume of a gorilla with that of *Australopithecus*, since the latter was patently a lithe and smaller-bodied creature as compared with the gorilla.

Despite this fact I find the endo-

cranial volume in *Australopithecus* to be 520 ccs. If we add 20 per cent, which is a reasonable amount to allow for subsequent expansion, we find that its adult endocranial volume would be 625 ccs. An adult gorilla has been reported with an endocranial volume of 610 ccs. But the usual range according to Keith is (females) 370–580 ccs. and (males) 420–585 ccs. The average volume for adult gorillas lies therefore in the vicinity of 475–500 ccs. A well-developed female gorilla in Professor Drennan's Department of Anatomy, University of Cape Town, provides an endocranial volume of 500 ccs. and an equally splendid male a volume of 575 ccs. If we look upon the Taungs child as an average specimen of his or her group and allow for adult *Australopithecids* the range obtaining today for adult gorillas, we may expect in them a fluctuation of from 518–733 ccs. This figure would bring their range of brain fluctuation within the range of fluctuation for *Pithecanthropids* arrived at in a similar fashion.

But the brain and intelligence of *Australopithecus* is rather to be compared with those of the chimpanzee which stands nearest to it in cranial, facial, and bodily form. From the data of Bischoff and Ranke it is known that the endocranial capacity in chimpanzees varies from 409–469 ccs. in adult males and from 345–413 ccs. in females, although cases are known where the volume has fallen as low as 290 ccs. Hence the average volume in

adult chimpanzees lies in the vicinity of 375–430 ccs., that is roughly 100 ccs. less than in adult gorillas and 200 ccs. less than in the adult *Australopithecus*.

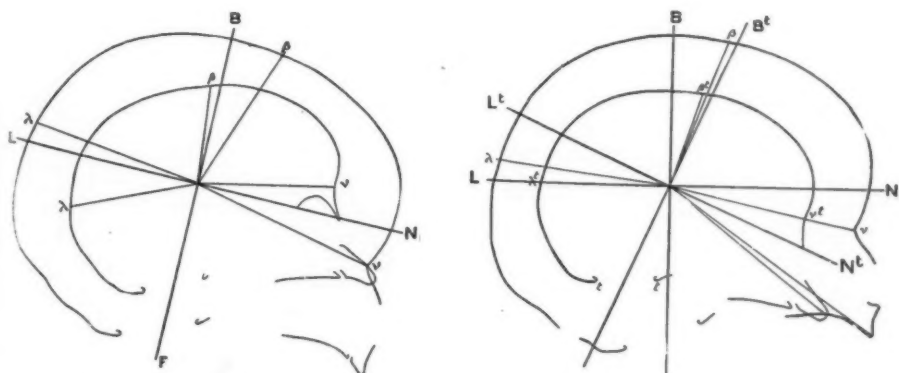
If we take Dubois' figure (850 ccs.) for the endocranial volume of *Pithecanthropus*, then the estimated endocranial volume of the adult *Australopithecus* (625 ccs.) lies about midway between that of the adult *Pithecanthropus* and the average for adult chimpanzees (400 ccs.).

Quite apart from the question of size there are numerous features about the shape and fissure pattern of the endocranial cast of *Australopithecus*, all highly technical, which denote the great advance of its brain beyond that of all living anthropoids.

These features, which concern more particularly the parietal association area of cortex (between the territories for vision, hearing and tactile discrimination) and the pre-frontal cortex (which is concerned with translating into bodily activity the information stored in the parietal memory area) are of such a nature as to lead me to believe that the brain and bodily form of the South African man-apes had attained a stage of organization which lifts them out of the category of the living anthropoid apes and places them certainly in a separate genus and probably in a separate family of beings intermediate between the chimpanzoid group of anthropoids and the most primitive known forms of mankind, the *Pithecanthropidæ*.



A restoration of the head of *Australopithecus* made by the well-known artist A. Forestier under the direction of Professor G. E. Smith, F.R.S. and published in the *Illustrated London News*



Left; Sagittal profile of the Taungs skull and of a child six years old  
 Right; Similar to left, but with the profile of the Taungs skull rotated so as to bring the "nasion radii" (line joining common center and root of nose) into coincidence in each type.  
 From the profiles shown above and similar data, the eminent scientist Professor W. J. Sollas of Oxford supports Professor Dart's conclusion that "*Australopithecus* is doubtless generically distinct from all known Apes, and in those important characters by which it differs from them it makes a nearer approach to the Hominidae" (mankind)



# Thomas Jefferson—Palæontologist

By FREDERIC A. LUCAS

Honorary Director, American Museum

WASHINGTON will ever be known as the Father of His Country, but Jefferson may well claim to be the Father of Palæontology. Others described fossils sent them from America, but Jefferson was among the first to pay them careful attention, and the first and only president to bring them to the White House. "Dolly" Madison, so we are told, found the big east room of the White House convenient for drying clothes; Jefferson used it for laying out the bones which he had secured from the famous Big Bone Lick, Kentucky, and many a palæontologist has wished he had similar space for his material. This may be called the first Palæontological Laboratory in America.

Cotton Mather (1712) may probably be credited with having presented our Mastodon to the world, and he was christened by Blumenbach in 1799, who unfortunately bestowed upon him the name of Mammut, but to Jefferson and Peale belong the credit of really introducing him to the society of his fellow fossils. Jefferson, indeed, seems to have cherished a faint hope that the Mastodon might still linger in the unexplored territory west of the Mississippi, and the Expedition of Lewis and Clark, the predecessor of the later Surveys West of the 100th Meridian, was, we believe, charged to keep an eye out for him.

By the courtesy of Mr. Lewis S. Gannett, we are able to publish a little-known letter of Jefferson's relating to the Mastodon, and the information of which he writes is taken from the *Itineraries and Correspondence of Ezra Stiles*, president of Yale from 1778:

Hartford, June 10, 1784

SIR:

After I had the pleasure of seeing you in New Haven I received information that you were in possession of several facts relative to the huge bones of the Animal incognitum found in America, or of the Mammoth as the Russians call the same animal whose bones they also find in the Northern parts of their empire. Mons.<sup>r</sup> de Buffon the celebrated Physiologist of the present age, who has advanced a theory in general very degrading to America, has in this particular also adopted an opinion which I think not founded in fact. It is that this animal was the same with the elephant of Asia and Africa. I think it certain that it was a different animal, having therefore on a particular occasion drawn his opinion into question I am still anxious of getting every additional information on the subject which may serve either to confirm or to correct the conclusion I had formed. I take the liberty therefore of asking from you a communication of whatever facts you may have become acquainted with as to this animal, as I shall not leave Boston till the 28th inst. any letter to me forwarded thither by post will probably come safe. perhaps it may be new to you that the bones of this animal have been lately dug up in the Salines of North Holston in Lat. 36°-30' which is much further south than they have ever before been found. I understand from different quarters that the Indians believe this animal still existing in the North & North West tho' none of them pretend ever to have seen one. It is said that the bones abound on the upper parts of the Missouri. to a friend of science I know I need make no apology for the liberty of this application. after repeating your assurance of the pleasure with which I shall render any services in my power to the institution over which you so worthily preside, as well as to yourself personally, I have the honor to subscribe myself with the most perfect esteem & respect Sir

Your most obedient  
& most humble serv.<sup>t</sup>

TH: JEFFERSON

Received June 19, 1784. Ans'd. 21 June.

The reverend Doctor Stiles

President of Yale College, New Haven

And in a letter from Thomas Jefferson to Ezra Stiles, dated Paris, July 17, 1785,<sup>1</sup> he writes:

I thank you for your information as to the great bones found on the Hudson River. I suspect that they must have been of the same animal with those found on the Ohio; and, if so, they could not have belonged to any human figure, because they are accompanied with tusks of the size, form and substance, of those of the elephant. I have seen a part of the ivory, which was very good. The animal itself must have been much larger than an elephant.

Extracts from the Diary of the Rev. Edward Taylor, of Westfield, wc. he kept from 1682 to 1714:

... 1705. On the 23d of July "one of the Gentlemen of the Council at York carried thither a monstrous Tooth that weighed four pounds & three quarters, said to be one of the great Teeth of a man, whole & sound on the Top but much decayed in its fangs one of which being hollow contained half a pint of Liquor. It was dug out of a Bank or Hill that rose some 30 or 40 feet above the place, about 26 Miles below Albany, at a place called Claverack. They found another Tooth, that seemed to be a fore tooth that was four fingers broad; and dug up Bones that when they came to the Air turned to Dust, but one Bone they took up, judged a Thigh Bone, of a man, seventeen foot long."

The Diary adds,

This Acco.<sup>t</sup> was given B<sup>o</sup> Weekly News Letter for the Week ending August.

In June, 1706, he has this further about the Giant:

On the 14th one Koon, a Dutchman, that came from Albany, brot to my house & shewed me another Tooth of the Monster buried at Claverack, like a Grinder Tooth with three Ridges on its Top & as hard as stone, the fangs much decayed. It was as big as a great Fist & weighed two pounds & an ounce. And he brought two pieces of another Bone conjectured to be of the Wrist, being about a third part of the Bone if split down in its Length. The perfect Bone looking like dull Oliviant was nigh an Inch thick and the porous inward part great. The Bone if it had had the other two parts joined to it would it is judged have

<sup>1</sup>The Writings of Thomas Jefferson, edited by H. A. Washington. Washington, Taylor and Murray: 1853, I, 364.

been as big as the Calf of a Man's Leg of the biggest size. The Dutchman asserted that they took up a Bone judged to be the Knee Bone that was about a foot in its Diameter; and the place where the Bone lay was 25 paces long, according to which the Monster was judged above 60 or 70 foot high. The Indians flocking to see the monstrous Bones upbraided the Dutch with Unbelief in that they would not believe the Report of a monstrous person w<sup>c</sup>. they had told them from their Fathers, vix. that about 240 years ago there was a monstrous person as high as the Tops of the Pine Trees, that would hunt Bears till they took the Trees, & then would catch the n with his Hands, and would go into the River 12 or 14 feet deep and catch 3 or 4 or 5 Sturgeons at a time & Broil them on the Fire for his food. The 17th day two other Dutchmen brought another Tooth as big again that weighed Five pounds; it had three Furrows on the Top four ridges.

Extracted from the original Manuscript, Oct. 20, 1760, in Westfield.

Uncle Eldad adds about the Giant that he remembers hearing his Father conversing about it with the Dutchmen, & that the Tradition among the Inds. was that the Giant "was peaceable & would not hurt the little Indians," and the little Inds. would give him meat to eat & he would receive it kindly; tho they said they always was afraid of him. They however want afraid of him when they approached him with a piece of meat or food, w<sup>c</sup> he would take without hurting them. He would knock the Bears off the Trees with his first or a Club. . . . When the Indians first saw Vessels passing in the Sound off against Pancatuck, they said at first it was Weetucks a coming again. . . .

About 1705 Mr. Taylor wrote a poetic Acco.<sup>t</sup> of the Gyant found then at Claverie below Albany—and says that about forty years before (or perh. 1666) he heard a Story of an Ind. Giant of incredible Magnitude & disbelieved it till he saw the Teeth, which he weighed, one above Two pounds & another full five pounds. He was told by the Dutchmen that the Grave or Extent of the Skeleton was Twenty-five paces, & they dug up a Thigh bone measuring seventeen feet long & a knee pan a foot Diam. The Ind. has often told the Dutch of this Giant who they said was as tall as the Pine Trees & died Two hundred & fourty years before.

The Thigh Bone was found & took up June, 1705, so he died about 1465.—A Tooth weighed four pounds & three Quarters. Grandfather Taylor says: "Two other Teeth after were took up and were Weighed by myself in my house in Westfield; one weighed five pounds, it had three furrows on the Top & was as hard as a stone; the other Two & one ounce. These Bones the Indians about Fort Albany flocking to see upbraided the Dutch of Incredulity for not believing them who told them that about 40 years before that Time they had an Indian as tall as the tall pine Trees, that would hunt Bears till they were treed & then take them with his hands & wade into Water 12 or 14 foot deep & catch Sturgeons 3 or 4 or 5 at a Time & broil & eat them."

The animal associated with Jefferson's name, however, is one of the great ground sloths, a group of animals peculiar to America, where they once ranged from Patagonia to Oregon. The first of these big animals was found in Argentina in 1789; the specimen described by Jefferson was found about ten years later.

In 1797, when Jefferson was packing his "mails" to go to Philadelphia to be inaugurated as Vice President, he included a number of bones from a cave in Green Brier Co., Virginia, on which he based a communication to the American Philosophical Society in which he termed the animal *Megalonix* (Jefferson 1799 A. Hay), to which the French naturalist, Desmarest, later affixed the specific name *jeffersoni* in recognition of its distinguished discoverer. The title of Jefferson's com-

munication was "A memoir on the discovery of certain bones of a quadruped of the clawed kind in the western parts of Virginia"; the bones themselves are preserved in the museum of the Philadelphia Academy of Sciences.

That Jefferson was not sure of the affinities of his "find," thinking it to be a carnivore and comparing it with a lion, is not surprising; neither were the European naturalists certain of the relationships of *Megatherium*, and a Spanish zoölogist objected to associating it with the little, sluggish sloth because "all the other edentates could dance in his carcass." Moreover, to encourage Jefferson in his belief that the claws were from some huge carnivore, there were well authenticated accounts—at least reports from very reliable sources—of the occurrence of some huge beast of prey in Virginia—a beast big enough to kill and half devour a horse. And it shows Jefferson to have been a pretty good anatomist that when he received a description of *Megatherium*, he added a postscript to his memoir noting the similarity between bones of *Megatherium* and those of *Megalonix*.

Not merely palæontology owes a debt of gratitude to Jefferson, but science in general, and as Doctor Goode says, "Had he not been a master in statecraft he would have been a master in science."



## Notes from Field and Museum

### ASIA

CENTRAL ASIATIC EXPEDITION.—Letters telling of the progress of his own work and including the latest news of Mr. Nelson's movements have been received recently from Walter Granger.

Following are a few excerpts:

Nov. 13, 1925.—"I am entering upon my winter's work at Wanh sien. Nelson is with me and both of our wives are along, preferring the cold raw Sze-chuan winter climate to the loneliness of Peking. We are due in Ichang at the lower end of the Ganges tomorrow; I tranship at that point for the upper river and Nelson will engage a small junk and proceed up through the gorges, examining the caves as he goes. His winter promises to be an exciting one and I hope a profitable one. My own district, about Wanh sien, is reported to be unusually quiet just now, but the Gorge region is always infested by roving bands of robbers and discharged soldiers with whom the traveller always has to take a chance. At Yen-ching-kao I hope to add something to the fauna already obtained, to get better specimens of those forms represented hitherto by fragmentary remains, and will especially keep a sharp eye out for further evidence of man and the higher apes."

Dec. 23, 1925.—"Pit-working has been at low ebb this fall, but is starting up now and I am hoping to reap my harvest later in the winter. A pretty fair skull and jaws of *Aeluropus* as well as several jaw fragments and teeth from the same pit are about all I have to date which is worth recording. There were four or five individuals of this bear in this pit, although ordinarily he is a scarce creature. I think I got none of him the second winter. There is no war and no organized banditry hereabouts now, for which I am grateful, for I do not feel quite so secure this year as before when I had Jim Wong with me."

Feb. 21, 1926.—"The fossil pits here are not being worked as extensively as they were both years before, and the great majority of the pits which have been dug have proved either entire failures or have yielded scanty and poor material. I have a small collection and a few choice things and am hoping for better success during this last month. Fortunately I can, and do, turn my hand to zoological

collecting, and I now have a fairly exhaustive collection of the birds and mammals of this region, as well as many of the other vertebrates."

April 10, 1926, S. S. 'Kut-wo.'—We came down the river without incident, although the Nelsons who preceded us from Wanh sien to Ichang, were shot up a bit, and one Chinese soldier passenger killed. Arriving in Hankow we found the railway cleared to Peking and so I dispatched four of our six boys, trusting to luck and Buckshot's level head that they get through. The other two boys and Nelson and I, with our wives, are going to Shanghai and thence by sea to Tientsin. Shipped six boxes of fossil and artifacts—our winter collection—from Hankow to New York. I never expected to be seasick travelling from Sze-chuan to Peking, but the Yellow Sea is pretty choppy at this time of year and I expect I am in for it. The only redeeming thing about this business is that we have had a chance to see the lower Yangtse. The river is seven or eight miles wide here and at one time this morning we were almost out of sight of land."

Two letters from Doctor Matthew give interesting news as follows:

April 14, 1926, Tientsin.—"I had expected to write you from Peking by this time, but am hung up here for the present. I had an uneventful trip across, but learned on the way over that the railroad routes to Peking are out of commission, as the bridges were blown up some months ago and have not been rebuilt. I secured passage from Shanghai to Tientsin by steamship—a little cargo boat with accommodations for eight saloon passengers, and arrived here last Sunday, the 10th of April, only to find that the railroad from here to Peking is also out of commission for the last two weeks. Until last Sunday it was still possible to get up by automobile, but since then all autos have been turned back and had to return. Andrews was scheduled to be here today, but a wire from him in reply to my message sent on arrival, says that it is impossible for him to get through, as the roads are too dangerous now for travel. So I am stuck here until I hear from him again or until auto or train traffic is resumed. That may be any day as the Kuo-min-chun now in control at Peking appear to

be on their last legs and are expected to abandon the city and retreat to Kalgan very soon. Then whichever of the "allies" attacking it enters and takes control will probably restore order and communications without delay. A newspaper report says that Andrews had a rather narrow escape from a bomb. He took refuge under a flat car near the station and one end of the car was splintered up by the bomb. However, I do not understand that they expect much if any more of that sort of thing.

"I am much afraid that all this fighting will tend to delay our start and disorganize Andrew's plans more or less. But he will probably have foreseen the situation as possible or probable and adjust his program as far as it could be done. I have had no word from anyone in Peking except for the message from Andrews that I spoke of above so cannot give you any news of the party.

"I hope everything has been going well at the Museum and with best wishes to all the staff. . . ."

April 20, 1926, Peking.—"I reached here last night after having been delayed a week in Tientsin by interrupted communications. The trip of 83 miles took from 8 A.M. to 8:30 P.M. to get through, but they are restoring things to normal quite rapidly. Granger and Nelson have not arrived yet but are expected tomorrow night. Hill and Beckwith are here. Young is up at Kalgan, and in his turn incommunicado, as the Knominchun troops are between here and Kalgan now. Andrews hopes at present to be able to get away about the first of May—but he will report to you on the general situation.

"I went over the collections that have been cleaned up by Olsen and his assistants. They have accomplished a remarkably large amount of first-class preparation of rather difficult material, some of it very difficult, and have cleaned up all of last summer's collections except what was sent to New York. The cost figures so far as I have been acquainted with them, are astonishingly low, and certainly vindicate the policy of cleaning up material here. . . .

"The first specimens I saw were the 'Coryphodon' skulls. . . It is, so far as I can judge offhand, identical with the types of *Eudinoceras* in the premolars, hence quite a bit different there from *Coryphodon*. I see no reason for placing the formation in the

Lower Eocene or separating it from the Irdin Manha.

"A magnificent big Titanotherium out of the super-Shara Murun beds equals or exceeds the largest American skulls—cf. our No. 492. Incomplete unfortunately, only the back of skull arches and part of palate with two molars. Several fine Titanotherium skulls out of the Shara Murun (or Irdin Manha) one with lower jaws, neck and fore limbs and feet associated. Two or more long-legged rhinoceroses with skulls that suggest an ancestor of *Baluchitherium* in the *Trigonias* stage of evolution. . . .

"The prize specimen is the *Baluchitherium* legs and feet—not much of the legs, but the feet are extraordinarily fine. The reduction of the lateral digits, especially of the second digit, is greater than in any other rhinoceros and the toes are excessively short. The trapezium and fifth digit, especially the former, are relatively more reduced than in *Teleoceras fossiger*; the forefeet considerably longer than the hind, but not much larger. Separate specimens of *B.* include a femur, an anterior dorsal and some rib fragments. I think that with casts of these specimens and the inferences one can make from their proportions and with the data that I hope to get at Leninograd of Borissiak's specimen, we should be able to make a plaster reconstruction of the skeleton. I can figure out most of it now, except for the character of pelvis, length and curve of backbone and length of ribs.

"Andrews' present plan is to begin with the Shara Murun district and dump us all out there for some three or four weeks of intensive collecting in the new localities found last year and prospecting for other fossiliferous pockets in the extensive exposures that lie to the southward. This will also involve some careful stratigraphic studies which must be tied up closely with the fossil collecting and with previous collections, so that we can clear up the exact relations of these Upper Eocene faunas and fix the true position of the red beds that overlie them and of the underlying red bed (Arshanto). Granger, Beckwith and I can work well together on this problem.

"The fighting in this district has interfered seriously with Andrew's plans for the expedition; indeed it is remarkable to me that he has been able to get through so much with such conditions to face as have prevailed this winter.



"I spoke with Grabau over the phone this morning and hope to meet him and have a talk over some of our problems this week. . ."

A Peking newspaper dated April 13, fully confirms the report in the New York papers that Roy Chapman Andrews had twice narrowly escaped death during an air raid in which bombs were dropped around the Hsi Chih railway station in Peking. Mr. Andrews and his Chinese assistant, Mr. Lo, were in a motor car when a bomb was dropped within forty feet of the car. When a second bomb came even closer they abandoned the car. Mr. Andrews took refuge under a freight car and crouched behind one of the iron wheels. A bomb exploded just on the other side of the car and one of the iron fragments struck the earth within a few inches of his nose. On the margin of the newspaper he writes to President Osborn:

"All well—don't worry. This *was* a narrow escape but bombs don't strike twice in the same place. It was rather amusing after all. Expect we'll get off May 1st. At present we are completely isolated. We watch the battles from the roof of the hotel and have 'Bombing Breakfasts' there in the A.M.

R. C. A."

Under date of April 14, Andrews writes from Peking:

"I haven't time to write just now but I'll tell you the news later. As I write, an airplane is dropping bombs in the city. It is getting to be rather annoying. I got cars a week after we arrived . . . and our stuff and two motors are at Kalgan. At present a terrific battle is going on about us and guns booming all day and night. Matthew safe in Tientsin. Burden due there in few days. Granger and Nelson on the way up from Shanghai.

"I'll get the expedition off but it is about the most difficult job I've ever been up against. However it is *fun* and I never worry."

MR. AND MRS. DOUGLAS BURDEN, on their way to a collecting expedition in the Dutch East Indies, called at the headquarters of the Central Asiatic Expedition in Peking at a very exciting time, when the opposing Chinese armies were struggling for the possession of the city. At the latest reports both armies stood between Andrews and Mongolia, and it was doubtful whether he could succeed in getting the expedition through the lines.

CRETACEOUS MAMMAL SKULLS AT LAST.—For several generations palaeontologists have bewailed the fact that, during the long ages of the Cretaceous in which the dinosaurs were dominant, the mammals, with few exceptions, completely escaped preservation as fossils; at least if they were preserved their remains have been destroyed during the millions of years of subsequent wear and tear on the earth's strata.

The chief exceptions are a few very fragmentary jaws and teeth of small mammals hitherto found in the dinosaur beds of Montana. But last year the Third Asiatic Expedition, while collecting the dinosaur eggs in the desert of Gobi, found in the same formation parts of six skulls and a number of lower jaws of small mammals. These priceless specimens have been worked out of the matrix and have recently been studied by Dr. W. K. Gregory of this Museum and Dr. G. G. Simpson of the Yale Museum. They report that these little skulls fully accord with the inferences of Huxley, Osborn, Matthew, and others that the structural ancestors of all the higher branches and sub-branches of the mammals would be found to be small "insectivores" with primitive brains and "tritubercular" cheek teeth.

THE MORDEN-CLARK ASIATIC EXPEDITION has successfully met and overcome all the initial obstacles on its journey to the Russian Pamirs by way of Afghanistan. After securing permits from both the British and the Russian governments the expedition got safely over the Burzil pass, which is the most difficult one on the Gilget Road to the Russian Pamirs.

PRESIDENT OSBORN has recently received from COLONEL FAUNTHORPE information telling of the accumulation of new and interesting material for the Asiatic Hall of Mammals. Colonel Faunthorpe, who is in the field in India, has secured, among other specimens, the parah stag, the four-horned antelope, and a small series of the hispid hare, a very rare animal. Colonel Faunthorpe is striving to complete the leopard group, for which he seeks a female and two cubs.

#### AFRICA

CHAPIN-SAGE EXPEDITION.—From East Africa James Chapin, of the Chapin-Sage Expedition reports the successful beginning of the field work. The expedition plans to traverse Central Africa and to ascend Mount Rouwenzori to study the effects of tempera-

ture, altitude, and other factors on bird life and distribution.

CARL AKELEY writes from Mombassa that the members of his party were recovering from the "flu," that he had met Chapin and that the expedition was proceeding satisfactorily. One of Mr. Akeley's principal objects is to secure material, including photographs and color sketches, for the background of his gorilla group, the gorillas themselves having been collected on his previous expedition and being now mounted and placed temporarily on exhibition. Mr. Akeley's eloquent pleas for the protection of the gorillas against ruthless collectors undoubtedly influenced King Albert of Belgium, who has set aside a great tract in the Kivu district as a perpetual sanctuary for the gorillas and other animals.

AFTER the successful conclusion of the Vernay Expedition in ANGOLA Mr. Herbert Lang proceeded to SOUTHWEST AFRICA and thence to Cape Town, collecting on the way. Some of his material has already arrived safely at the Museum.

THE DEPARTMENT OF PREPARATION at the Museum, although handicapped by the necessary absence of several of its members on some of the expeditions mentioned in these notes, is doing its full share toward preparing exhibits for the great halls of African and Asiatic mammals which will be located respectively in the Roosevelt Building and in the new northeast wing.

#### BAHAMAS

DR. ROY W. MINER is expecting to sail shortly for the Bahamas to obtain additional material for the new coral-reef group to be installed in the Hall of Ocean Life. The expedition is made possible through the generosity of Mr. John H. Phipps who will accompany the expedition and has placed at its disposal the use of his yacht "Seminole." The personnel of the expedition will include Mr. C. E. Olsen, modeler on Doctor Miner's staff, and Mr. F. L. Jaques, artist. Doctor Miner will leave on June 25 for Nassau, while the main part of the expedition will sail for Miami on July 9. Among other things the expedition hopes to secure sketches for the half-dome cyclorama forming the upper part of the group, as well as casts and models of reef fishes. Diving helmets will be utilized for securing additional observations of coral-reef life.

#### WEST INDIES AND SOUTH AMERICA

WEST INDIES.—Mr. H. E. Anthony, curator of mammals, recently returned from the West Indies, where he had been collecting and studying the fossil mammals of the islands of Mona and Desecheo. These fossils are of special interest on account of their bearing on the problem of the origin of the mammal fauna of Porto Rico. Mr. Goodwin of the department of mammals remains in the field.

SOUTH AMERICA.—Mr. Tate is collecting for the department of mammals in Bolivia, and Messrs. Watkins and the Olalla brothers in Brazil.

#### PANAMA

DR. WILLARD G. VAN NAME, associate curator of lower invertebrates has recently returned from a trip to Panama with a collection of 950 specimens of marine invertebrates obtained mostly on the Pacific side of the Isthmus, particularly at the Pearl Islands and at other points in the Bay of Panama, as well as at Barro Colorado and Gatun Lake. This region has been practically unrepresented in the invertebrate collections of the Museum.

#### YUCATAN

THANKS to the kindly interest of Mr. George Palmer Putnam and Mr. Gregory Mason, MR. LUDLOW GRISCOM represented the American Museum of Natural History on the Mason-Spinden Expedition to Yucatan last winter. This expedition, which was primarily engaged in searching for ruined cities of the ancient Maya civilization, left for Belize, British Honduras, on January 6, and sailed north from there along the coast of eastern Yucatan in a specially chartered schooner. The particular interest of the bird department was in obtaining specimens of the peculiar species found on Cozumel Island off the Yucatan coast, and to determine definitely whether they occurred on the adjacent mainland. Mr. Mason afforded Mr. Griscom every opportunity for these investigations. Landings were made at many places along the hitherto unexplored mainland and adequate collections were obtained on Cozumel Island.

More than 200 species were definitely recorded during the trip, and quite unexpectedly seven proved new to science. A number of species were found not previously recorded from Yucatan, and several others

were previously unreported in our collections. A large colony of rosy flamingos was one of the most interesting discoveries, as this species is found in only four other places in the world, in most of which it has been rapidly decreasing. A detailed report of the results of the expedition is in course of preparation.

#### GREENLAND

THE GREENLAND EXPEDITION, under the direction of Mr. George Palmer Putnam and financed chiefly by Mr. Harrison Williams, expects to leave New York about June 20 in an auxiliary schooner commanded by Capt. Robert Bartlett. The object of the expedition will be to secure some much needed material for the new Hall of Ocean Life, especially specimens of the narwhal. Mr. H. C. Raven, associate curator of comparative anatomy of the Museum, will be the chief zoologist and Mr. Van Campen Heilner of the department of fishes will be the ichthyologist of the expedition.

#### GULF OF CALIFORNIA

MR. KEITH SPALDING of Pasadena, California, is cruising in the Gulf of California in quest of big game fishes. Mr. Escherich of the Museum's department of preparation is his guest and they are hoping to secure some fine specimens for the new Hall of Fishes.

#### THE MEDITERRANEAN

DOCTOR AND MRS. MURPHY will be the guests of Mr. and Mrs. Jesse Metcalf on a cruise in the Mediterranean, which will give Doctor Murphy an opportunity to collect birds and fishes.

#### MEETINGS OF SCIENTIFIC SOCIETIES

Doctor Chapman and Doctor Murphy represented the Museum at the INTERNATIONAL ORNITHOLOGICAL CONGRESS held in May at Copenhagen. Doctor Chapman will also go to England to the Royal Geographical Society meeting in June.

THE SOCIETY OF MAMMALOGISTS and the MUSEUMS ASSOCIATION held their spring meetings at the Museum.

#### CONSERVATION

The "SAVE THE REDWOODS" movement, actively backed by President Osborn of this Museum, President Grant of the New York Zoological Society, and President J. C. Merriam of the Carnegie Institution has been successful in saving the magnificent stand of

redwoods in Bull Creek Flat 200 miles north of San Francisco.

It must be very gratifying to the leaders in this movement to learn that due to their foresight and planning this magnificent forest will be handed down to posterity to enjoy.

#### UNDERSEA PAINTINGS

Through the generosity of MRS. WILLIAM H. BLISS of this city, the Museum has received an addition to the series of beautiful undersea coral paintings made by Mr. Zarh Pritchard in the coral lagoons of the Society Islands. To secure these paintings, Mr. Pritchard donned a diving suit and, seated on the bottom of the sea, made preliminary sketches with oil colors on waterproofed canvas. The finished paintings are most delicately and beautifully executed on sheepskin and give a remarkable picturization of the soft beams of sunlight playing upon the eroded arches and pinnacles of ancient coral reefs, crowned and fringed with living coral colonies.

Mrs. Bliss's donation is one of the finest of the series already presented to the Museum.

Another similar and exquisite painting has recently been presented by the artist himself. Thus the Museum now possesses a fine representation of Mr. Pritchard's work depicting the submarine life of the Pacific islands.

Eventually these reef paintings will be displayed in the Museum's new Hall of Ocean Life, and will be exhibited in connection with the great West Indian coral-reef group, one of the central features of the new hall.

#### FANCY SAPPHIRES

A NOTABLE GIFT, recently made to the gem collection by Mr. J. P. Morgan, consists of nine corundum gems of the variety known as "fancy sapphires." These are of unusual size and of a rich color and, with the fine series of these gems already displayed, form a magnificent suite.

#### VON LUSCHAN COLLECTION

FRAU VON LUSCHAN, widow of Professor von Luschan of Berlin, recently visited the Museum and gave much valuable data pertaining to the great von Luschan collection of human skulls and skeletons, which was acquired two years ago by the Museum, chiefly through the generosity of Mr. Felix Warburg.

#### PUBLICATIONS

MR. CHILDS FRICK has recently returned from the Paris Museum, where he studied the

fossil mammals of the French later Tertiary formations. His expedition last summer in the Miocene of New Mexico yielded, as an unexpected prize, a well-preserved skeleton of a large extinct mammal that combines characters of the dogs and bears. It proves to be an American representative of the extinct European genus *Hemicyon*, and, together with other new material, has led Mr. Frick to the interesting conclusions—recently published in the *Museum Bulletin*—that the bears were already present in this country before the Lower Pliocene, and that the family is too old to be derived from the extinct European genus *Ursavus* as previous authors have supposed; also that *Hemicyon*, *Ursavus* and some fossil genera from India constitute a natural group, which he names the Hemicyoninae, distinct from both the dogs and the bears.

**TIME MEASUREMENTS OF GLACIAL CLAYS** — More than ten thousand years ago, the margin of a great continental glacier stood over the site of New York City, and adjacent lowlands. At the same time in the Hackensack valley stratified beds of glacial clay were deposited in a fresh-water lake as the ice front retreated slowly northward from year to year. A remarkable feature of these clays is that they are seasonally banded: the "summer" layer composed of fine sand and coarse clay particles, corresponds to the melting period of the ice; the "winter" layer consisting of pure clay, represents the cold season of each year when no streams flowed into the lake from the ice front and the fine clay particles, held in suspension following the summer incursions, quietly settled to the bottom of the lake. In the clay banks the "summer" and "winter" layers alternate in position. Frequently there is a gradation from the summer period into the winter, but the close of the "winter" deposition is sharply set off from the following "summer" sediments.

In *Notitates* No. 209, recently published by the Museum, Associate Curator Reeds gives an interesting account of his studies of this remarkable series of seasonal deposits. He recognized the varve, the amount of aqueo-glacial sediment deposited in one year, as the unit of deposition and time measurement. From five clay pits near Little Ferry, New Jersey, Doctor Reeds has established a composite section of 43 feet of clay which contains five thousand seasonal layers, or 2500 varves representing as many years. In a curve of the

varves, comprising four graphic charts, he has shown the thickness of the varves which vary from year to year, in fact, they run in series which represent climatic fluctuations and variable periods of melting of the ice.

Doctor Reeds' report on the Little Ferry district serves as a key section for only the middle portion of the Hackensack valley. When a complete set of clay sections has been secured from other localities in the Hackensack and Hudson River valleys and each locality has been studied and correlated with the present elevations, data will be available for a definite record of the postglacial history of the region.

**A NEW HANDBOOK.** "The Story of the Minerals" by Herbert P. Whitlock has recently been published as No. 12 of the Handbook Series. It is in no sense a text book but is intended to increase public appreciation of the Morgan Memorial Hall. Some particularly impressive specimens are both illustrated and described in this handbook.

IF THERE are any subscribers to NATURAL HISTORY who feel that they would care to donate copies of the earlier issues to the American Museum Library, the gift would be very much appreciated. There are frequent calls for complete files which the Library is no longer able to fill.

## HONORS

THE WOLLASTON MEDAL, was awarded to Professor Henry Fairfield Osborn at the annual general meeting of the Geological Society of London, Feb. 19, 1926, in recognition of his distinguished services to science as a paleontologist.

When handing the medal to Mr. Boylston A. Beal, councillor of the Embassy of the United States of America, for transmission to the recipient, the president of the Society, Dr. John Williams Evans, C. B. E., F. R. S., addressed Mr. Beal as follows:

"In handing to you the Wollaston Medal, the greatest honor which this Society has the power to bestow, for transmission to Professor H. F. Osborn, I should like to express the admiration which the Fellows of this Society feel for his long record of valuable researches on the Palaeontology of the Vertebrates. In his early expeditions to collect mammalian remains from the older Tertiary rocks of Wyoming, he recognized the importance of ascertaining the exact stratigraphical position in which they were discovered, so as



to be able to trace with certainty the succession of extinct forms, and to determine the relative ages of those found in different parts of the world. In 1910 he published his conclusions in 'The Age of Mammals in Europe, Asia and North America.' In a long series of publications he has dealt with almost all groups of Mammals and Reptiles; but

THE PEKING SOCIETY OF NATURAL HISTORY organized and adopted a constitution on September 21, 1925, and now has a membership of more than one hundred, among whom are many of the leading scientists of China. At their annual meeting held March 12, Honorary Membership was conferred upon Professor Henry Fairfield Osborn. The



Obverse and reverse of the Wollaston Medal, the highest honor conferred by the Geological Society of London

especial reference may be made to his important contributions to our knowledge of the Rhinoceroses, Horses, Titanotheres, and Dinosaurs. In his handsome volume on the 'Men of the Old Stone Age, their Environment, Life and Art,' which was first published in 1915, and has gone through several editions, he had made a welcome addition to popular scientific literature.

"He has held numerous important posts, especially in the American Museum of Natural History, New York, of which he is now the President, and has, in connexion with that Museum, organized a complete survey of the geological succession of the higher Vertebrates of North America.

"During recent years he has directed a systematic search for fossils in the Cretaceous and Tertiary strata of Mongolia, and large and important collections of previously unknown forms have been obtained, which he is now studying. Not his least service to Science has been the foundation of a flourishing school of Vertebrate Palaeontology, which already includes the names of a number of brilliant men of science, who are working in cordial co-operation under his inspiring leadership."

Society will publish a periodical entitled "The Bulletin of the Peking Society of Natural History."

PROFESSOR OSBORN, has also been elected Honorary Fellow of the Royal Society, an honor bestowed upon only three other American citizens, Benjamin Franklin, Alexander Agassiz, and Benjamin Thompson (Count Rumford).

We quote from *Nature*, May 8, as follows:

"In the early days of the Society's history, it was the custom, on the election of specially notable philosophical inquirers and workers, not of English birth, to send them an ornate diploma carrying the Society's seal. Birch, the historian, records that, in 1680, 'Dr. Gale was called upon for the diploma to be sent to Mr. Leewenhoeck, and it was ordered that the society's seal should be affixed to it, and that a silver box should be provided for it.'"

"Professor Osborn is among the most distinguished palaeontologists of our time. His first publication (1883) dealt with the structure of the brain in amphibia; later memoirs dealt mostly with fossil vertebrates. One of the results of his work is the more precise determination of the relative ages



of the extinct mammals of North America. As director [president] of the American Museum of Natural History, Professor Osborn has made the institution world-famous. He has had distinctive influence in establishing a school of younger palæontologists. In 1918 he was Darwin medallist of the Royal Society."

Professor Osborn is the second member of the Museum staff to be thus honored by the Royal Society, Dr. W. D. Matthew, who is a British subject, having been elected a Fellow in 1919.

DOCTOR G. CLYDE FISHER, curator of visual instruction and in charge of the astronomical department of the American Museum, is the recipient of the honorary degree of Doctor of Laws, conferred upon him June 14 by the faculty of Miami University.

ROY CHAPMAN ANDREWS RECEIVES THE DOCTORATE.—The first academic recognition of the scientific accomplishments of the Central Asiatic expeditions of the American Museum is the award of the honorary degree of Doctor of Science to Roy Chapman Andrews by Brown University, at a special convocation on February 24, 1926. On receiving the degree from the hands of President Faunce, Mr. Andrews made a brief speech of acceptance.

This honor gives the greatest pleasure not only to Mr. Andrews but to all of his associates on the expedition and in the American Museum.

THE SEVENTIETH BIRTHDAY of the famous Belgian palæontologist, Professor Louis Dollo, will be commemorated in a Festschrift volume by fifty scientific colleagues in Europe and America. Professor Osborn, Professor Gregory, and Doctor Matthew will represent the Museum in this volume.

#### APPOINTMENTS

PROF. BERTRAM G. SMITH of New York University Medical College and PROF. A. B. DAWSON of New York University have recently been appointed research associates in the department of herpetology. Professor Smith is well known for his embryological studies on *Cryptobranchus*, while Professor Dawson has made many brilliant anatomical and histological investigations of *Necturus* and other vertebrates.

#### LEWIS B. WOODRUFF

In the death on November 27, 1925, of Lewis B. Woodruff, two divisions of science lost a conscientious and devoted worker. Although a lawyer by profession, Mr. Woodruff gave his time increasingly to the study of nature, and for many years prior to his death had dedicated practically all of his energies to this pursuit. Originally interested in ornithology, he made a very thorough collection of North American birds and their eggs, and became familiar not only with the appearance but with the notes of all of the summer and winter residents and the birds of passage of this locality. But this early love was in time supplanted by an even more ardent devotion to entomology, and in this wider and less investigated field he found greater opportunity for research. In the course of the years he studied such groups as the beetles, the dragonflies, and the tree-hoppers (Membracidae), contributing valuable papers as well as building up embracing collections.

At the time of his death he had charge of the assembling of the material for the volume on insects that is to be issued by the New York Academy of Sciences in its series of studies on the flora and fauna of Porto Rico and the Virgin Islands, and he was himself planning to write up one or more of the groups to be considered in this volume. With characteristic thoroughness he prepared himself for the task by visiting the islands last year.

Mr. Woodruff was keenly interested in the activities of the New York Entomological Society and a constant attendant at its meetings. He served it in several official capacities, including that of president. Among the bequests to various institutions that he made was one of \$10,000 to that organization. His collections he designated for deposition in the Museum.

#### NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total membership 8937.

*Associate Benefactor:* MR. HARRISON WILLIAMS.

*Patrons:* MESDAMES ISAAC H. DIXON AND GERALDINE R. DODGE.

*Fellows:* MRS. Z. CHAFEE.

GEN. COLEMAN DU PONT.

MESSRS. JOHN EDWARDS BARBOUR, WILLIAM DU PONT, CLIFFORD WARREN SMITH.

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*Sustaining Members:* MESDAMES H. P. DAVISON, AMASA STONE MATHER, THOMAS N. McCARTER, CLARENCE C. WILLIAMS.

MISS GERTRUDE SANFORD.

MESSRS. JAMES F. CAVANAGH, HENRY S. STURGIS, ALBERT WORTMANN.

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## ASTRONOMY

### JULY-AUGUST

The forthcoming issue of *Natural History* will be devoted to the subject of Astronomy, a most timely arrangement, since the plans for the proposed Hall of Astronomy have just been completed. One article will deal particularly with the plans for this addition to the buildings of the American Museum of Natural History. This has been written by Mr. Howard Russell Butler, adviser to the architects. Another paper on the use of models in an Astronomical Museum has been contributed by Dr. Henry Norris Russell, professor of astronomy at Princeton University and director of the Halstead Observatory.

The three recent total eclipses of the sun visible in the United States are vividly described by one of the leading authorities in this branch of Astronomy, Dr. S. A. Mitchell, professor of astronomy at the University of Virginia and director of the Leander McCormick Observatory. This is especially fitting since the American Museum now has on exhibition in the Pro-Astronomic Hall oil paintings of these eclipses arranged as a triptych. This series of eclipse paintings had its inception in the engagement of Mr. Howard Russell Butler, N. A., by Mr. Edward Dean Adams, to paint the solar eclipse of June 8, 1918, at the Station of the U. S. Naval Observatory at Baker, Oregon, and the subsequent gift of this painting to the American Museum. A physicist by early training and an artist by life training, Mr. Butler is probably the best qualified man in this country, if not in the world, to undertake the painting of this thrilling phenomenon which lasts at most only a very few minutes. Mr. Butler has prepared an article telling how he paints eclipses and lunar landscapes.

Other astronomical topics will be treated in this number by men who are leaders in their respective fields. Dr. William Wallace Campbell, president of the University of California and director of the Lick Observatory, will have an article on the American Museum's Collection of Meteorites; Dr. George Ellery Hale, honorary director of Mt. Wilson Observatory, will write about Electrical Vortices of the Sun; Dr. Charles P. Berkey, professor of geology at Columbia University, will contribute an article on The Early History of the Earth; and Dr. W. J. Luyten of the Harvard College Observatory will discuss Outer Universes.

Dr. Clyde Fisher, in charge of astronomy at the American Museum, will describe the new Zeiss Projection Planetarium, which he examined last summer in Jena and in Munich. It is now a part of the proposed plan to include this wonderful piece of apparatus in the Astronomic Hall.

